MODERN PLASTICS



SEPTEMBER 1946

R v. 24 Sept. 1946 - Feb. 1947



A CLEAN SWEEP FOR DUREZ PLASTICS

The parallel development of Hoover Vacuum Cleaners and Durez phenolics points up an era in which household appliances and plastics have progressed together...and lightened further the labor of housekeeping.

For many years, the Hoover Vacuum Cleaner Company has recognized the unusual value of Durez phenolic plastics as a material for vacuum cleaner housings, functional parts and accessories. In fact, H. Earl Hoover once stated: "The special Durez plastics used for certain (Hoover Vacuum Cleaner) parts not only help reduce weight, they also add smart, modern contours, a lustrous scratch-proof finish. And because they're self-insulating, they simplify our design and assembly."

Durez Versatile

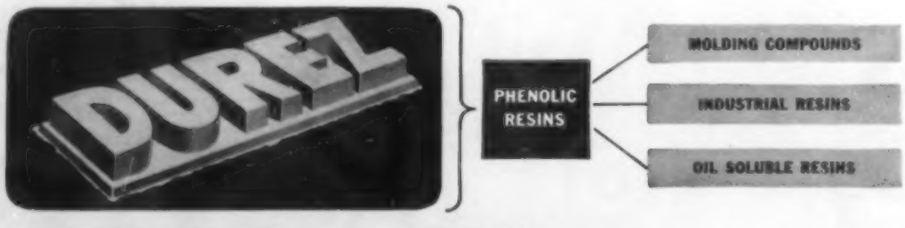
Non-resonance, impact strength, heat resistance, and dielectric strength . . . these are among the other characteristics of Durez phenolic molding compounds which gave development engineers the necessary freedom, in designing the vacuum cleaner to its present state of efficiency. Of utmost significance, however, has been our success in perfecting more than 300 modifications of a plastics material whose versatility has been recognized for years. A finer appliance than ever before, the Hoover of today uses more molded Durez than ever before.

About Your Problem

Perhaps you have a plastics material problem. If so, we urge you to consult your custom molder. New methods of preheating, molding and finishing greatly extend the advantages of his service.

Remember, too, the competent counsel of experienced Durez technicians plus a wealth of proved product development data is available for the asking.

Write to: Durez Plastics & Chemicals, Inc., 59 Walck Road., N. Tonawanda, N. Y. *Export Agents: Omni Products Corporation, 40 E. 34th St., New York 16, N. Y.*



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Hourly, Radio stations pause to identify their call letters—not that they deem this repetition necessary for their tuned-in audience . . . but to direct and welcome the incoming listener.

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So true is this of all products made of *the gem of plastics,* that we at Catalin would like to assist you in the thinking out and planning of your ideas — Inquiries invited.

CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE, NEW YORK 16, N. Y.

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THE GEM OF PLASTICS
Catalin

CAST RESINS • LIQUID RESINS • MOLDING COMPOUNDS

MODERN PLASTICS

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He runs his road with GEON-insulated wire



"Rainbow Cable" control wire developed and manufactured by Phalo Plastics Corp., Worcester, Mass.

GEON's *advantages make it ideal insulating material for instrument, home, industrial and utilities wiring*

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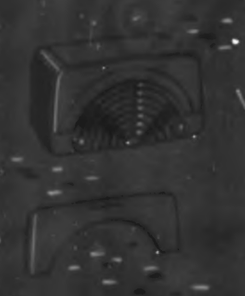
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Polyvinyl Materials

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Plastics show threatened by division

The year 1946 witnessed the birth of a baby to the plastics industry in the form of a National Plastics exposition. True enough, it was a sort of two-headed baby in that two shows were held instead of one, but the main idea given birth was a show. A two-headed baby is abnormal to say the least, and couldn't possibly live over a period of years. Yet the plastics industry needs and the public has indicated a great yearning to see a public showing of the plastic industry's productive genius.

The situation for 1947 looks none too good for the show baby. Two separate groups in the industry have announced plans not only for separate shows but separate shows to be held in the same place, Chicago, only 90 days apart.

This program makes perfect nonsense. Imagine an average molder in Boston spending $5000 or $10,000 to go half way across the country to produce a modest display in January and then doing the same thing all over again three months later before the same people. Imagine even a *Chicago* molder doing it without a tremendous amount of grumbling and many misgivings. The wastefulness of time alone in an era when every executive is up to his neck in production problems could be equivalent to the energy expended in producing enough polystyrene blocks to build a bridge across the Mississippi River—and just about as fruitful.

No matter how well the shows are conducted, each is certain to detract from the other. If the first should happen to fall down in the quality of its exhibits, the second will raise a cry from the populace: "What's the idea? Was your first effort a bust? Did you have to make another start?" Conversely, if the first show turns out to be a superduper exhibition of the highest grade, the populace will wonder why any industry should waste its energy on a second show and question whether or not the "right hand knoweth what the left hand doeth."

Furthermore, if the industry's efforts are divided, neither show will be representative of the industry's best work. We have yet to find a molder who has any desire to display his wares at both shows. The whole situation seems to us as bad as a man with two families whose time, energy and loyalty is barely sufficient for one.

The time for adjustment is short and action must be taken quickly if this mess is to be avoided. It seems reasonable for members of the industry to ask that representatives from the two groups, S. P. I. and S. P. E. get together and submerge their bias, politics and ambitions. It is logical to believe that reasonable men with the same objectives can get together on common ground. Is it too much to ask that each association appoint a Board of Arbitration, the members of which will meet in joint session and continue to meet until they have arrived at some method of pooling their efforts even if it should be so extreme as temporary amalgamation of the two associations for the purpose of conducting one great combined plastics show?

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. . out of INSUROK

. . Tough! . . Colorful! . . Uniform!

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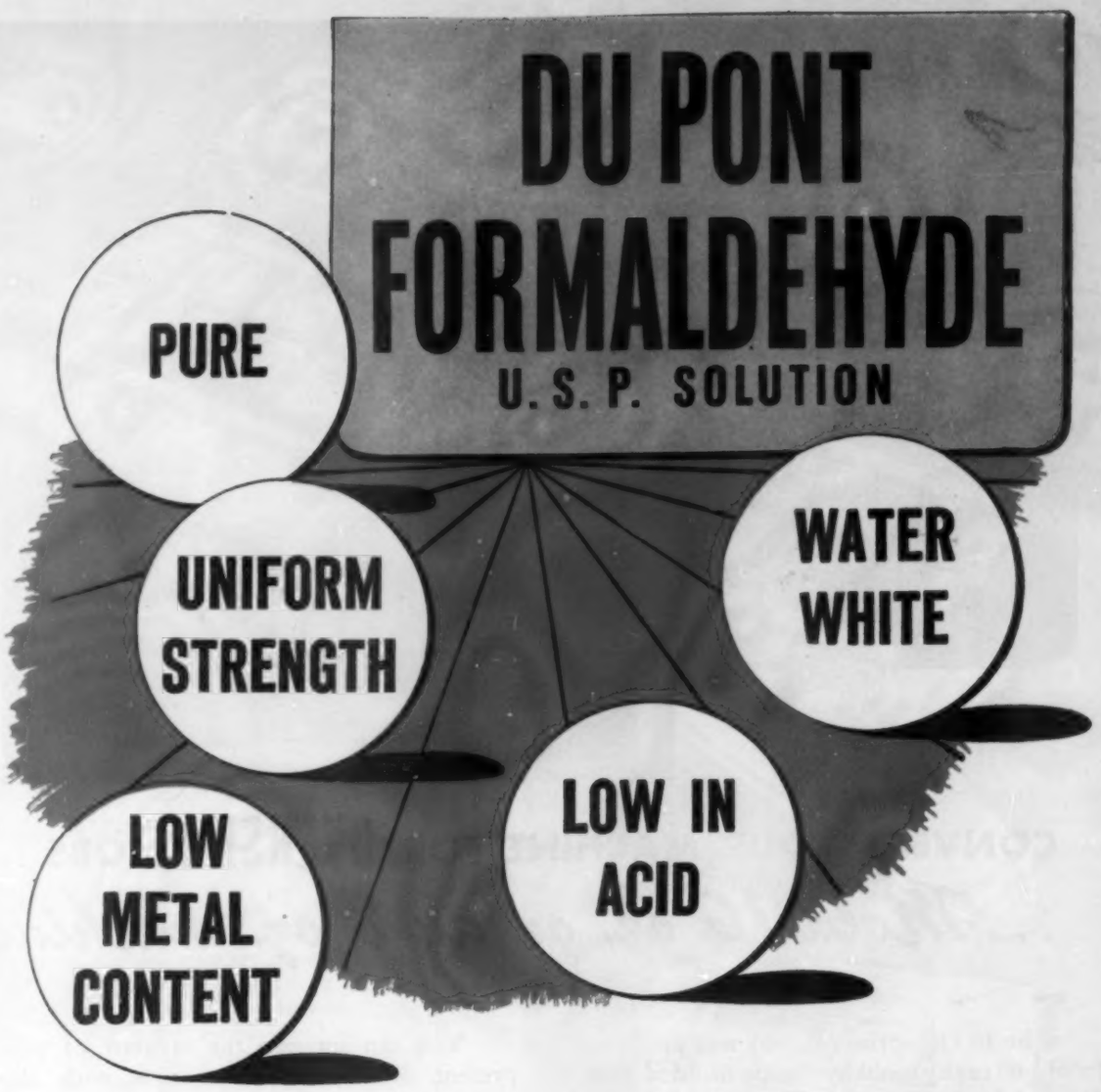
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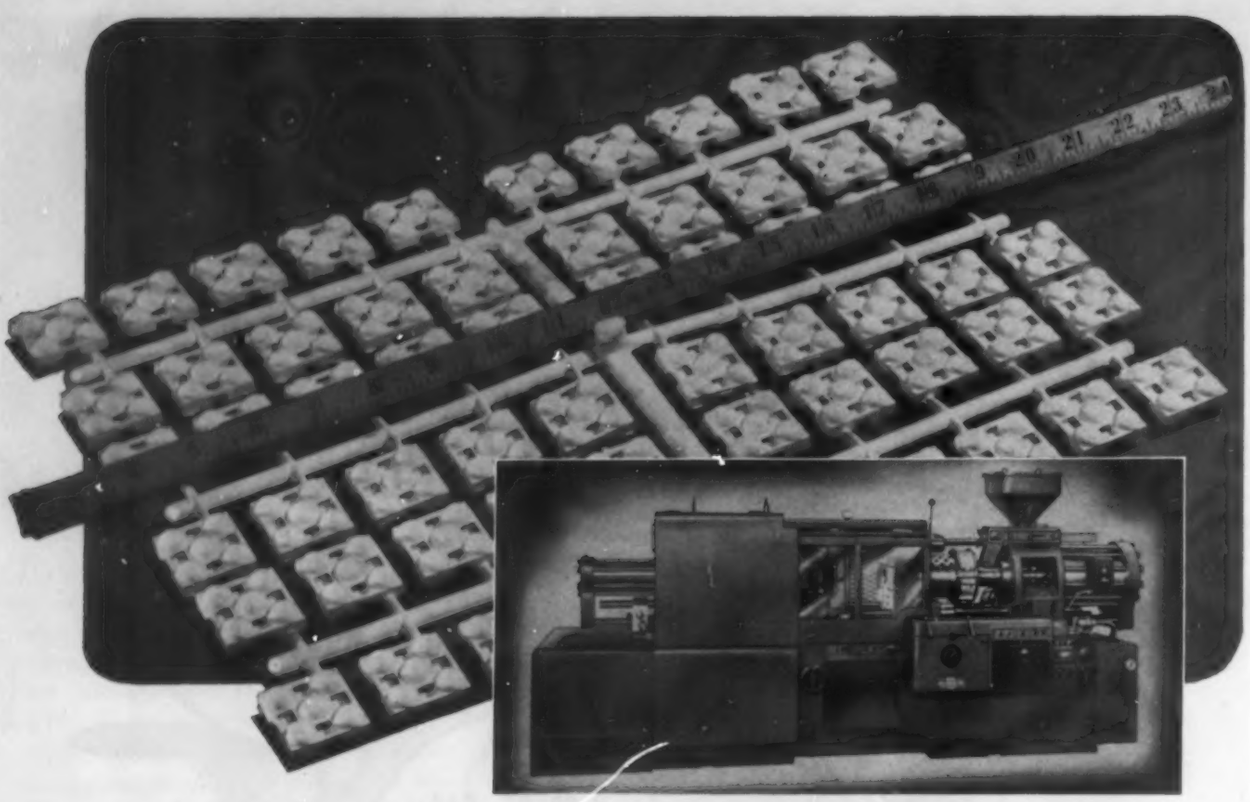
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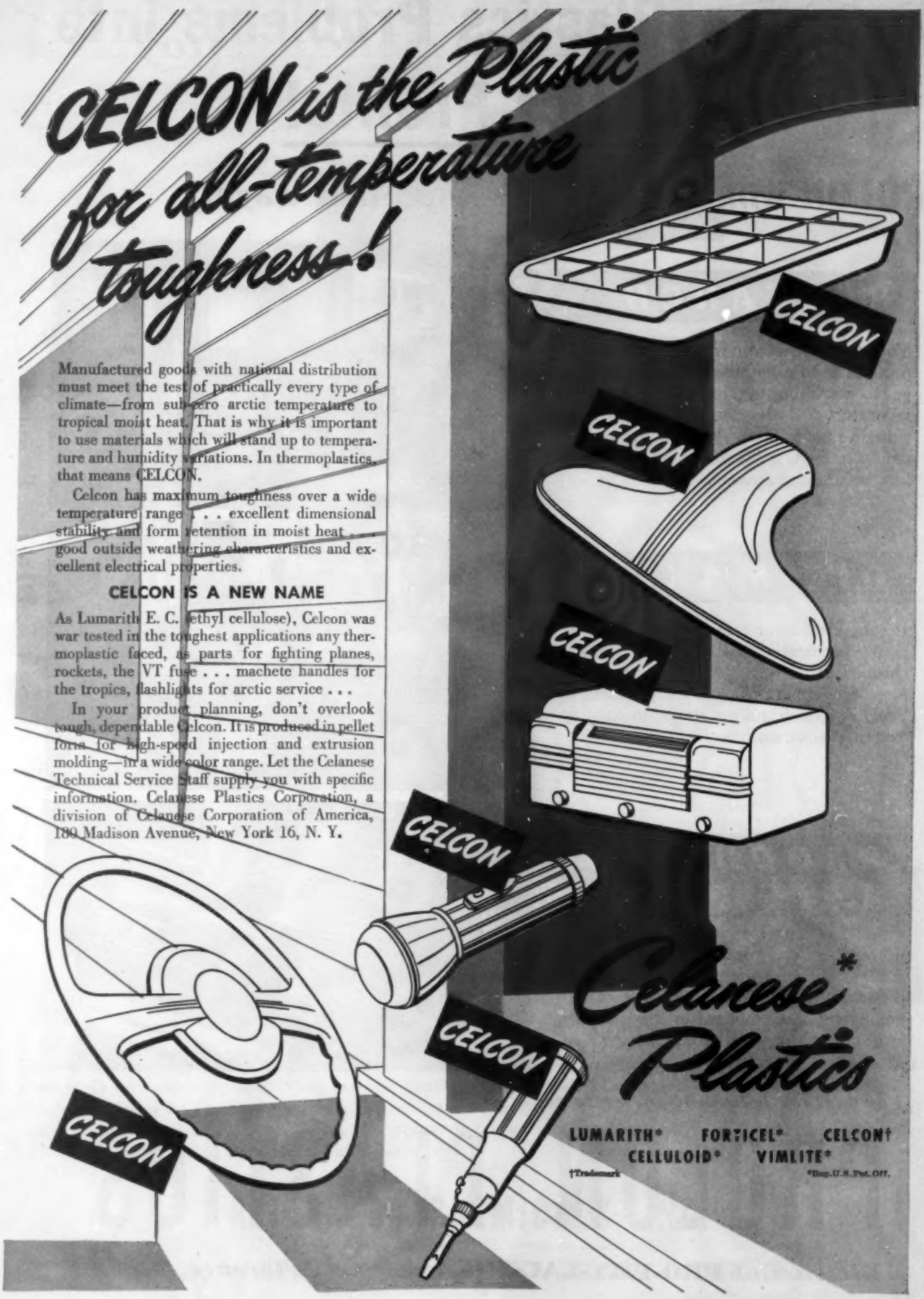
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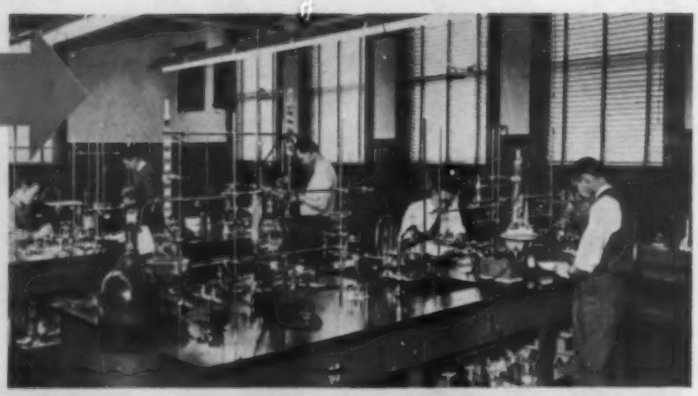
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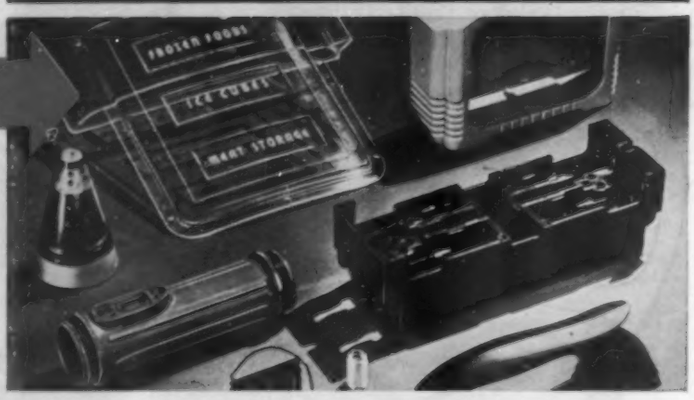
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Kurz-Kasch

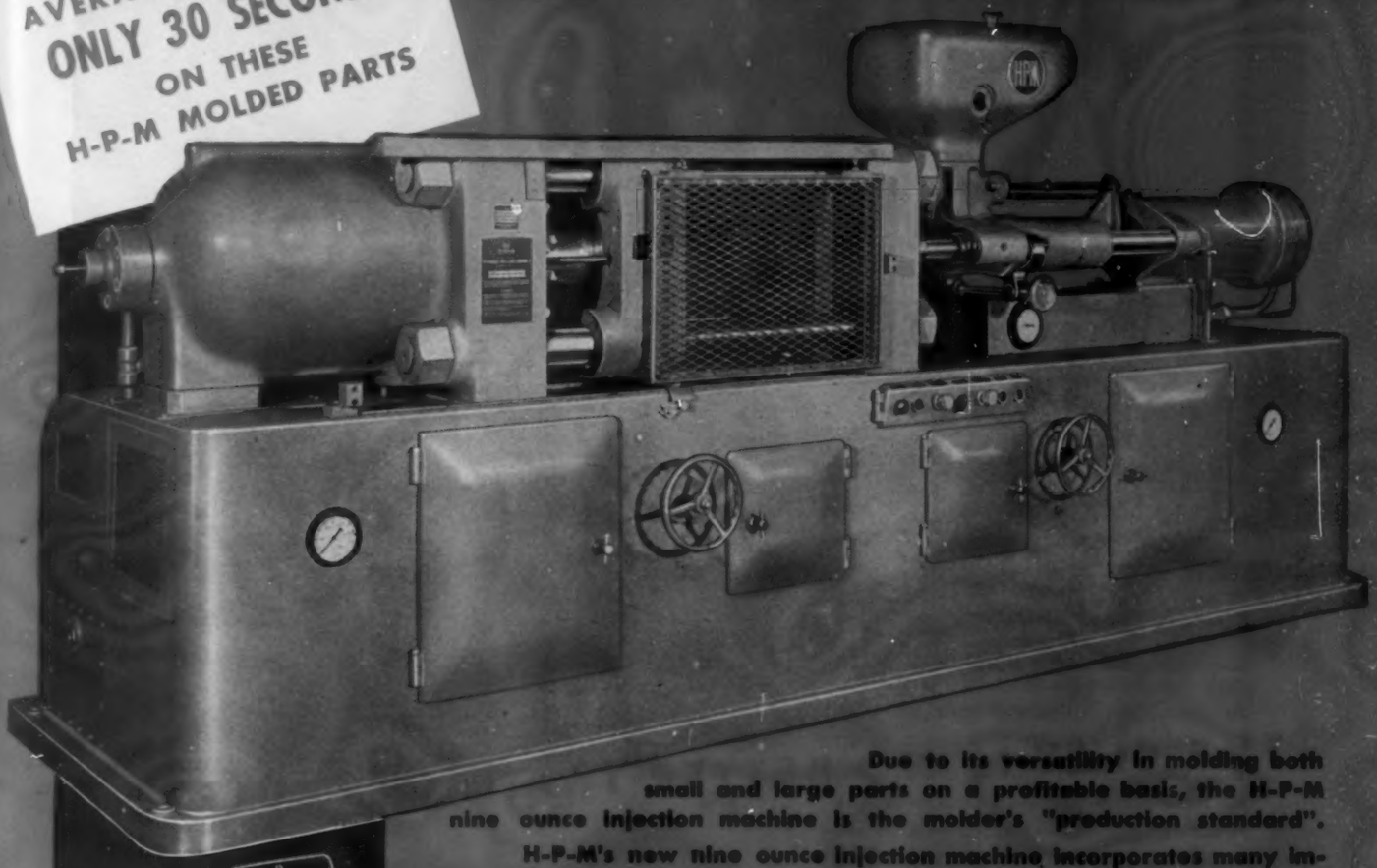
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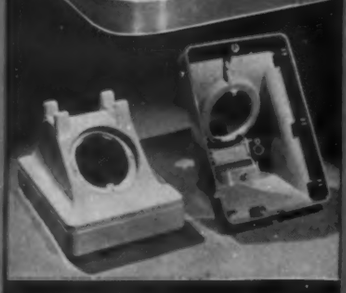
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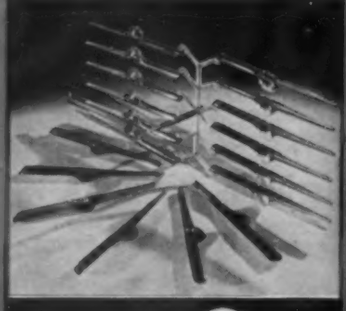


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ACETATES?

VINYLS?

ACRYLICS?

ACETATE BUTYRATE?

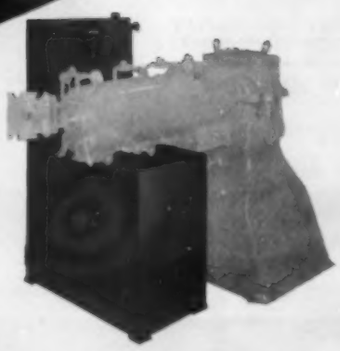
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NRM Oil Heating and Cooling Units Can Help You with Extruding and Injection Molding

TWO NRM MODELS ADAPTABLE TO YOUR PRESENT EQUIPMENT



8 KW MODEL:
Dimensions 38" x 20" x 31½", suitable for use with 1½" extruder or the smaller capacity molding presses, completely equipped for all service connections.



18 KW MODEL:
Dimensions 38" x 20" x 31½", — 59½". Note how snugly it assembles with 2½" extruder. Completely equipped with all controls for all service connections.

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Perhaps you too, can benefit by the use of this modern, well-designed equipment. It's easy to find out, simply write us for further details.



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General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION

THE PENALTY OF LEADERSHIP

In every field of human endeavor, he that is first must perpetually live in the white light of publicity. ¶ Whether the leadership be vested in a man or in a manufactured product, emulation and envy are ever at work. ¶ In art, in literature, in music, in industry, the reward and the punishment are always the same. ¶ The reward is widespread recognition; the punishment, fierce denial and detraction. ¶ When a man's work becomes a standard for the whole world, it also becomes a target for the shafts of the envious few. ¶ If his work be merely mediocre, he will be left severely alone—if he achieve a masterpiece, it will set a million tongues a-wagging. ¶ Jealousy does not protrude its forked tongue at the artist who produces a commonplace painting. ¶ Whatsoever you write, or paint, or play, or sing, or build, no one will strive to surpass or to slander you, unless your work be stamped with the seal of genius. ¶ Long, long after a great work or a good work has been done, those who are disappointed or envious continue to cry out that it cannot be done. ¶ Spiteful little voices in the domain of art were raised against our own Whistler as a mountebank, long after the big world had acclaimed him its greatest artistic genius. ¶ Multitudes flocked to Bayreuth to worship at the musical shrine of Wagner, while the little group of those whom he had dethroned and displaced argued angrily that he was no musician at all. ¶ The little world continued to protest that Fulton could never build a steamboat, while the big world flocked to the river banks to see his boat steam by. ¶ The leader is assailed because he is a leader, and the effort to equal him is merely added proof of that leadership. ¶ Failing to equal or to excel, the follower seeks to depreciate and to destroy—but only confirms once more the superiority of that which he strives to supplant. ¶ There is nothing new in this. ¶ It is as old as the world and as old as the human passions—envy, fear, greed, ambition, and the desire to surpass. ¶ And it all avails nothing. If the leader truly leads, he remains—the leader. ¶ Master-poet, master-painter, master-workman, each in his turn is assailed, and each holds his laurels through the ages. ¶ That which is good or great makes itself known, no matter how loud the clamour of denial. ¶ That which deserves to live—lives.

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Various control arrangements—to suit particular needs—are available with these presses. High and low pressure pumping units for obtaining a fast advance speed. Adjustable speed control for the high pressure stroke.

In addition, Watson-Stillman builds the most complete line of Hydraulic Molding Equipment available. This equipment includes Compression, Transfer Molding, Preform Machines for Transfer Molding, Vertical and Horizontal Injection Molding Machines, all in a wide range of capacities.

Let Watson-Stillman Plastics Engineers go over your molding problems with you. Write or call Watson-Stillman Company, Roselle, New Jersey.

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ITACONIC ACID



Molecular Weight . . .	130.10
Appearance	White, crystalline, solid
Melting Point	167-168°C.
Solubility in Water . . .	At 20°C. a saturated solution contains 7.6 grams of Itaconic Acid per 100 grams of solution.

This unsaturated dibasic acid, now available in research quantities, offers many possibilities as a raw material in the field of chemical industry.

It can be used as a raw material in the preparation of resins of various types.

Its esters can be polymerized to yield colorless, transparent plastics of varying characteristics, depending on the alcohol with which the acid is combined. They can also be co-polymerized with other monomers, opening a wide range of possibilities.

Its structure indicates that it might prove a useful raw material for the preparation of wetting agents.

It can be converted to citraconic or mesaconic acid and forms an anhydride.

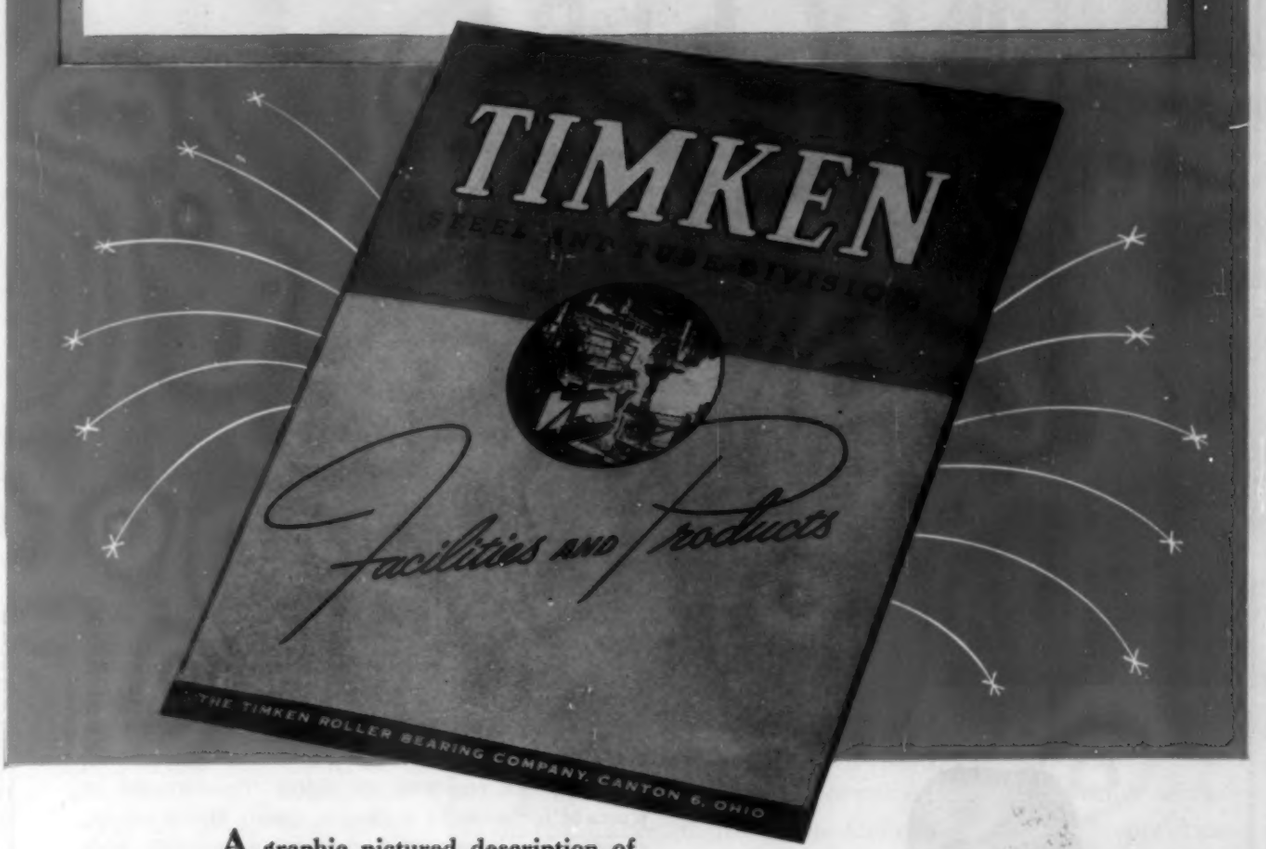
Reduction yields methyl succinic acid which, in turn offers other possibilities as a raw material.

Itaconic Acid is not yet being prepared in commercial quantities, but limited amounts are available for laboratory research.

For samples and further information, please inquire of Chas. Pfizer & Co., Inc., 81 Maiden Lane, New York 7, N. Y.; 444 West Grand Ave., Chicago 10, Ill. 605 Third St., San Francisco 10, California.

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mass produced to .001" tolerances

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The Press is standard

- for making quick and accurate small-scale pressing tests.
- for development, research and instruction work.
- for testing single cavity molds.
- for preparation of samples.
- and even for small-scale production.

The Carver Laboratory Press is small, compact,

- has a pressing capacity of 20,000 lbs.
- weighs only 125 lbs.
- operates under self-contained hydraulic unit, giving any precise variations in pressure that may be desired.
- large accurate gauge of finest construction is rigidly mounted on base.
- special gauges are available for low pressure work.

THE three Carver Laboratory Presses in the picture are only part of the Carver equipment in daily service in the Laboratories of the Celanese Plastics Corporation. Through chemistry and imagination, unrelenting research and tireless development, Celanese has broadened the usefulness of Plastics. Here, as in other prominent plastics laboratories, the Carver Laboratory Press has established its versatility and dependability through many years of service.

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eye appeal dictates lustre

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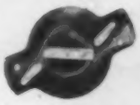
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QUALITY COATED ABRASIVES SINCE 1872

Look what Aluminum-Plastics teamwork can do!



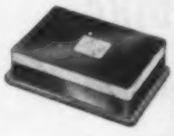
MECHANICAL strength can be added to molded parts without burdensome weight. Fastening inserts, or structural reinforcements, are light, strong; available in many cases from stock.



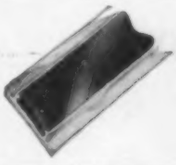
ELECTRICAL conductivity of aluminum is high. Perhaps you're thinking about a molded plastic electrical part where aluminum inserts provide the necessary conductivity. They're strong, too!



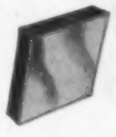
THERMAL properties of aluminum are excellent. Let's say you're designing a plastic product which must be air-cooled. You might use aluminum discs, molded in, as above.



DECORATIVE values of aluminum are a long story in themselves. Use it plain, or with frosty or mirrorlike Alumilite or colored finish (patented process). Remember, it's light!



EXTRUSIONS of plastic combined with extrusions of aluminum? Why not? One supplements the other, in beauty and strength. Alcoa Aluminum is available in many stock shapes.



LAMINATED plastics can be faced with aluminum sheet for a new idea in modern materials. Or, why not inset Alcoa Aluminum decorations in your dark laminates? Attractive!



FORMED plastic sheets team up well with Alcoa Aluminum, as in this navigator's dome. The whole assembly is light, strong, easy to mount. Is there a household idea here?



CHEMICAL properties of aluminum supplement those you like to stress in plastics. Can it help you in products for textile, process, petroleum, pharmaceutical, food industries?



—but what happens as the molding COOLS?

There are no stresses in your finished molded piece as you remove it hot from the mold. But what happens around the insert as your molding cools?

If your insert is Alcoa Aluminum, you need not worry about stresses set up by contraction of the plastic around it. For you will find the expansion coefficient of Alcoa Aluminum closely approaches that of your molding material.

Your insert may be a large metal part, inherent with the structure of the molded article. It may be a small threaded insert to hold an assembly screw, or a decorative panel of sheet aluminum, with a special finish. In any case, you'll agree the stress-freedom that comes with the use of Alcoa Aluminum inserts marks it *plastic's best friend in metals.* Both in temperature behavior and other properties (see left) it's your natural choice whenever metal is required in the plastic art. Your insert supplier will be glad to "make it of Alcoa Aluminum".

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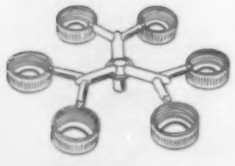
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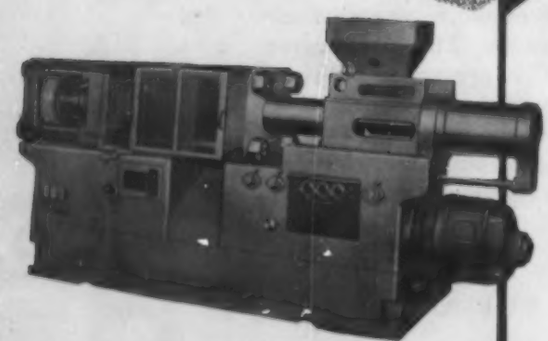
CHEMCOT has a high alpha cellulose (99%) and a low ash content. It is brilliantly white and absorbent and is furnished in sheets, rolls or in loose form.

We will give your inquiries concerning more definitive information or research samples our sustained attention.

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1. One screw adjusts die plate for perfect alignment — no flooding.
2. Equal pressure distributed by "Central-shaft" moveable plate support.
3. Full length pin-support in heavy-duty toggle assembly.
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HOBBING for PROFIT!

WHAT a difference *molds* make—in production costs; in product quality. And what a difference there can be in what *good* molds cost you!

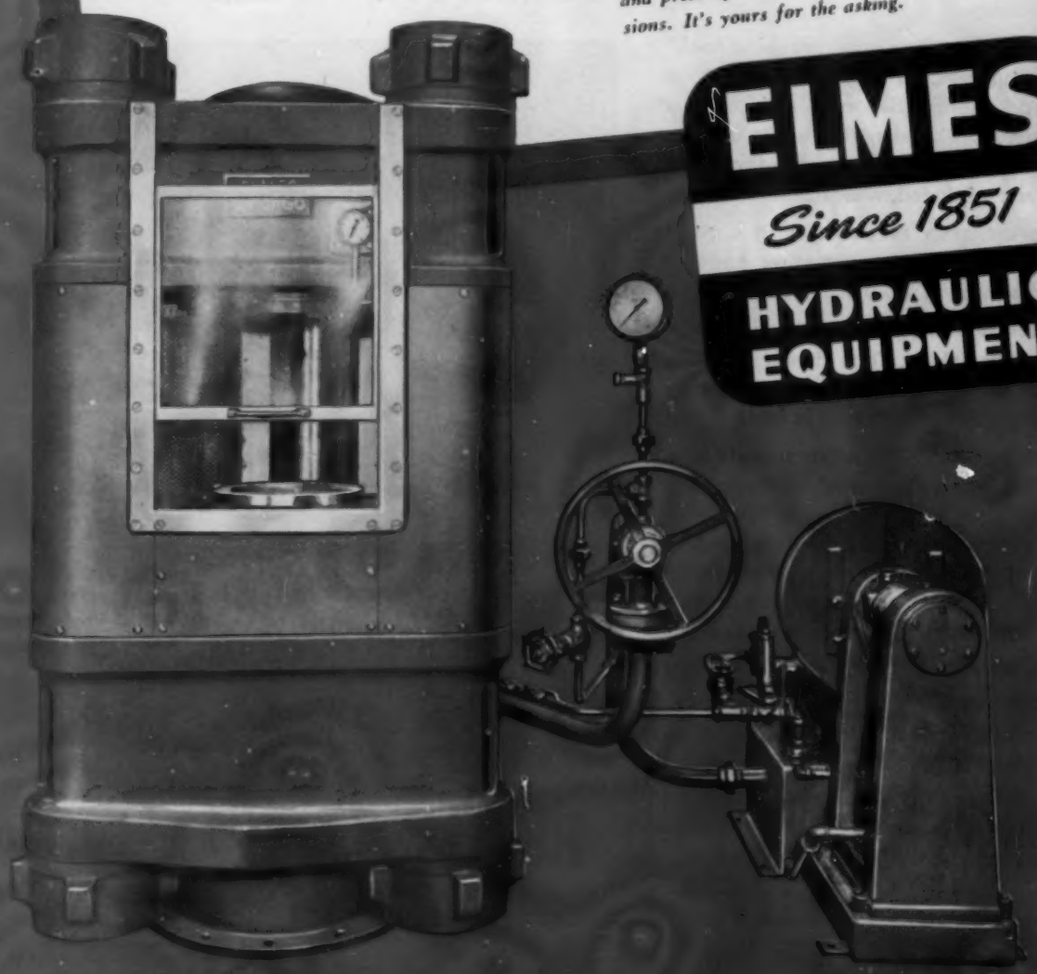
Duplicate die inserts, multi-cavities—even single molds with hard-to-make contours—cost less and work better when *accurately* formed by hobbing.

If you make molds, or ever expect to, investigate the *many* economies an Elmes hobbing press offers—in speed; ease of manipulation; precise accuracy; operator confidence; and dependable, long service.

The Elmes hobbing press is built for the *single* purpose of sinking intricate hobs into prepared blanks of cold steel. Irresistible force up to 10,000,000 pounds, and more, responds *instantly* to sensitive control.

Cavities hobbed on the Elmes press have an excellent start toward perfect completion. Types and sizes in compact three-column designs for all requirements. Optional accessories.

New Bulletin 1030A describes the hobbing process and press operation; gives specifications and dimensions. It's yours for the asking.



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"BURRS CAN'T BE TOLERATED in a good machine tool," said a Norton engineer. "First, they reflect on workmanship and quality. Second, they'd threaten injuries to operators by snagging waste used in wiping. When heads burred or broke, they had to be removed and replaced, wasting time.

"DRIVER SKIDS WERE ALSO FREQUENT with slotted screws, because of the extra pressure, causing injuries to hands banged against adjacent parts.

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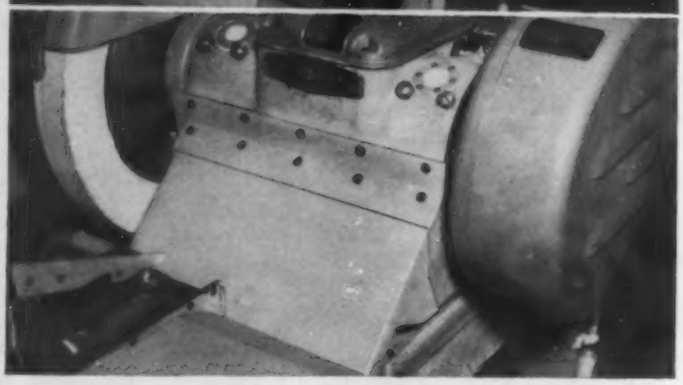
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"SCREW TIGHTNESS IS A 'MUST' in our machines, to eliminate vibration. We have to set-'em-up to the limit, which means a heavy torque load on the screwhead. With slotted screws this meant burrs, breakage, or driver skids, but the Phillips head can take it."





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We're proud of our old-timers at General Industries. Not just because of their collective 358 years of plastics molding experience; but mainly because they've applied their wisdom to the modern methods of today. Result . . . molded plastics that attain the hallmark of quality *plus*.

Naturally, we're always alert for every new scientific or mechanical development that means better results for our customers. Examples . . . the addition of heatronics to our plastics molding operation—the use of the finest and latest mold making equipment and the employment of infallible scientific testing instruments. But we temper our youthful enthusiasm with these men of age and experience who tell us whether or not new methods or machines will help us make your plastics molded job better or less costly.

It gives us a great feeling to know we've got our wise old-timers on which to depend, and we know you'll get great satisfaction and realize dividends from the knowledge that these years of wisdom are back of your finished product. Consult our skill and experience on your plastics molding problems.

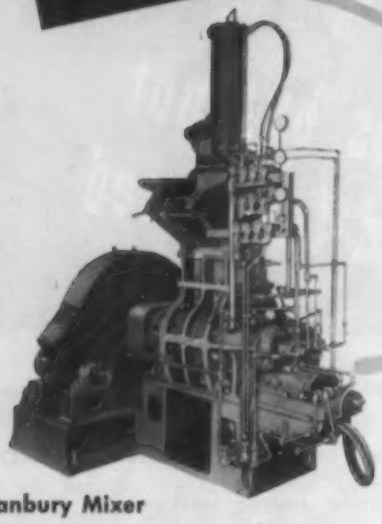
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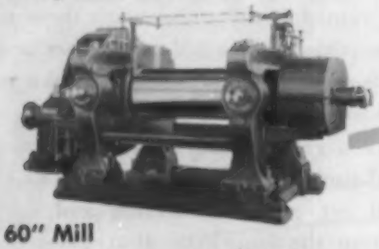
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22" x 60" Mill



24" x 66" Four-Roll Calender

Economical processing of textile coatings, plastic film and similar materials is dependent, to a large extent, on a continuous flow of production. Especially in calendering, once proper running temperature has been reached and the gauge accurately set, interruption of scheduled output is costly.

The processing set-up illustrated in the diagram has been developed by Farrel-Birmingham engineers, working in conjunction with plastics manufacturers, to provide synchronized production in the progressive steps of manufacture. The first two machines, the Banbury and the mill, have a capacity of approximately 1200 pounds per hour, and are in ideal balance with the calender for the majority of products. The calender is driven by adjustable speed motor so that its output speed may be set according to the gauge of stock being run.

A number of single and multiple installations of these *Matched Production Units* have been made in plastics plants. In fact, the combination has given such satisfactory service that it has become generally accepted as the standard production unit for plastic film and coatings. Other combinations of equipment can be supplied to meet individual requirements.

For further details of these Matched Production Units, *write for free copy of Bulletin No. 183, just off the press. No obligation, of course.*

FB-343

FARREL-BIRMINGHAM COMPANY, Inc.

ANSONIA, CONN.

Plants: Ansonia, Derby and Stonington, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston, Charlotte.

Farrel-Birmingham



It took the American conception of mass production to put America on top . . . and it takes WORK to keep America on the way UP! Free enterprise that makes practical use of great technological advances* and multiplies the benefits for *everyone*, is the American way to maintain progress. Let's work like Americans, for there's great work to be done . . . together!

• • •

** Technological advances in creation of essential papers for industry, and in adapting them to efficient processing, are available through MOSINEE. Call for MOSINEE paper technicians!*

MOSINEE PAPER MILLS COMPANY

MOSINEE • WISCONSIN

Essential Paper Makers

Please address your letter "Attention Dept. A"

Thinking about Hydraulic Presses?



Here are ways that Baldwin can help you

FIELD APPLICATION SERVICE

When you're thinking about the jobs you want presses to do . . . your production men may get some helpful tips from a Baldwin engineer. Long contact with the field, plus Baldwin participation in research projects, equip these representatives to discuss your problems from *your* viewpoint, and cooperate in finding the exact answer to your individual need.



STANDARD PRESS LINE WITH "CUSTOM-BUILT" FEATURES

When you're thinking about the presses for the jobs you want done . . . you'll find a line of modern Baldwin presses waiting to serve you. These presses include many of the "custom-built" features, developed through years of individual press design, that you ordinarily find only in special units. They are made available on standard models through efficient production methods in the Baldwin shops.



DESIGNS BASED ON LONG EXPERIENCE

Baldwin press designs are based on the accumulated experience of half a century devoted to designing and building hydraulic machinery. They reflect the engineering skill gained in meeting many problems in this field. We will welcome an opportunity to work with you. The Baldwin Locomotive Works, Philadelphia 42, Pa., U. S. A. Offices: Philadelphia, Chicago, St. Louis, Washington, New York, Boston, San Francisco, Birmingham, Houston, Cleveland, Detroit, Pittsburgh, Norfolk.

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BEAUTY . . . AND THE BRUSH BUSINESS

An industry takes on new life, with Du Pont NYLON and "LUCITE"



IN TOOTHBRUSHES TOO!

—the great majority sold are bristled with nylon. Long-lasting nylon bristles are preferred also in household and industrial brushes. In paintbrushes, they outlast hog bristles 3 to 5 times . . . paint smoothly, too.

The most beautiful brushes that people can buy today are also the most long-lasting. And they're buying *more* brushes . . . sales are 'way up.

Larger and larger percentages of the nation's hairbrushes are being bristled with Du Pont nylon . . . many of these with backs and handles of lustrous Du Pont "Lucite" acrylic resin. Nylon bristles are water-resistant . . . their resilience *lasts*. "Lucite" is sparkling and transparent—an ornament on any dressing table. Together, these Du Pont plastics have brought a vigorous new sales stimulus to this important industry.

"Lucite," nylon, and others of the Du Pont plastics are showing manufacturers in many fields the way to make old products more salable . . . or to bring out new products they have planned. You are far better equipped to improve *your* product, if you know the Du Pont plastics—all of them. Write for literature. E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Room 369, Arlington, N. J.

DU PONT
REG. U. S. PAT. OFF.
Plastics
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY



the plastic FOR ROUGH HANDLING!

Ethocel is *right* within your grasp! You'll find that out in numerous ways and places. For this Dow plastic is putting better handles on things —like that jug's spigot and that machete.

You'll agree that Ethocel is an able companion for "roughing it"—on vacations in the wilds and in your everyday life at home. It's rugged as a hunting knife—and just as smooth and handy!

Ethocel is welcome for its lightness. Yet it's strong and holds its shape. It won't warp or chip or split. And its soft sheen and warm, lively hues lend spirit to products.

Up-to-the-minute manufacturers have made Ethocel the standard material for many things Americans are buying in rising tempo. These manufacturers know that when you buy a flashlight made with Ethocel or a radio with an Ethocel cabinet, you're buying topmost satisfaction. They know that, in Ethocel, Dow research has given them—and you—a plastic for achievement, a plastic that's made to last!

PLASTICS DIVISION
THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland
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ETHOCEL

LASTING USEFULNESS IN PLASTIC

Ethocel is Dow Ethylcellulose, a tough material making durable molded products in wide variety . . . Dow also produces Styron, a brilliant plastic for refrigerator parts, clock cases, lighting fixtures, cosmetic containers, costume jewelry; Saran for long-wearing, colorful fabrics, resilient, non-rusting screen cloth and chemically-resistant pipe and tubing for specialized uses; Saran Film and Ethocel Sheeting for protective packaging; and Saran Latex and Resin for coatings and finishes.

Dow Plastics include: *Styron, Saran, Saran Film, Ethocel and Ethocel Sheeting*

DOW

PLASTICS

BASIC MATERIALS FOR FINER PRODUCTS

SMART HANDLING...
IN *Plastics*



Saw Handle, molded for Great Neck Saw Manufacturers, Inc., Mineola, Long Island.

This Mustang Saw Handle is a striking example of how skillful molding of the proper plastic material can increase a product's sales appeal. Two objectives guided its molding: First, to produce a handle possessing the toughness to withstand hard and constant usage; secondly, to give it an eye appealing handsomeness that would match its workaday usefulness.

A similarly correct use of the right plastic material may be just what you need to enhance your product with sales increasing eye appeal.

Let Elmer E. Mills Corporation designers, engineers, skilled and experienced in the most effective injection molding and extrusion techniques help you. Consult us freely and without obligation.



Write on your letterhead for the new Injection Molded and Extruded Plastics catalogue. Or, for detailed information about MILLS PLASTIC* pipe, tubing and fittings, write for circulars containing data and illustrations.

*Trademark Reg.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Plexiglas, Nylon, Polystyrene, Styron, Lustron, Loalin, Vinylite, Geon, Plexene, Polyethylene, Ceres, Forticel, [redacted]* Saran, and other Thermoplastic Materials.

153 WEST HURON STREET • CHICAGO 10, ILLINOIS

Amos DID IT... Right!



Hose Nozzle Connection for tank-type vacuum cleaner. Four plastic pieces (shown above separately and as a unit) are molded to assemble with hose and spring clips for quick, easy, air-tight connection.



Here's a step ahead in parts production in plastics . . . in product beauty and utility . . . in manufacturing efficiency and economy. This nozzle assembly for a new vacuum cleaner suggests to you what Amos can do in making your own product-planning a precise reality.

Exactness in size . . . in fit . . . in tolerances . . . *yes! Amos die making is right!* Underscore that point for your own advantage. Then add the fact of flawless molding and the accuracy of Amos finishing, and decide to call Amos for that "step ahead" you want in your own new products.

From engineering to finishing Amos does a complete job . . . and does it right. Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS, EDINBURGH, INDIANA
Division of Amos-Thompson Corporation
One of the Most Modern Plastic Molding Plants in the Industry



CUSTOM *Molders of*
Plastic Parts and Products
Injection Molding Specialists



When CATS hobnob with Canaries

UNUSUAL combinations, like the duet above, bring KYS-ITE to mind. It offers such unexpected combinations as great strength and lightness, ruggedness and beauty... plus the other "seldom-found-together" properties mentioned below.

GREAT STRENGTH WITH LIGHT WEIGHT — Preformed before curing, an even distribution of phenolic resin on interlocking fibres results in great tensile and compressive strength and with an impact strength up to 5 times that of ordinary plastics.

WIDE RANGE OF SHAPES—Complicated pieces with projections and depressions, large or small shapes and sections—all these and more, too, are molded successfully in KYS-ITE.

***KYS-ITE* CAN "TAKE IT"** — Unusually durable and resistant to abrasion, impervious to mild alkali and acid solutions.

INTEGRAL COLOR—KYS-ITE's lustrous finish is highly durable; the color is an integral part of the material itself. A wipe and it's bright!

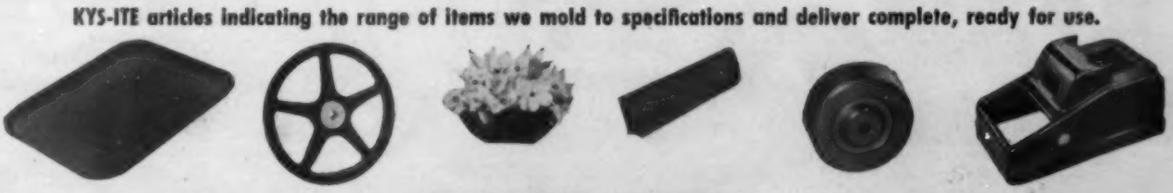
NON-CONDUCTOR—KYS-ITE's dielectric properties make it invaluable where safety is a factor. Also a non-conductor of heat. Non-resonant and non-reverberating.

CONTINUING HEAVY DEMAND FOR KYS-ITE prevents us from handling new specialty orders at this time. As manpower and materials become more available, we see this situation improving, however. In the near future we hope we can again offer our complete service on molded plastics problems.

KEYES FIBRE COMPANY
420 Lexington Avenue
New York 17, New York
Plant at Waterville, Maine

KEYES
MOLDED PRODUCTS

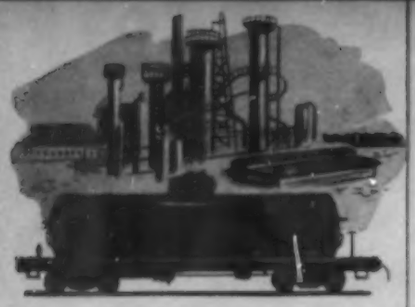
KYS-ITE articles indicating the range of items we mold to specifications and deliver complete, ready for use.



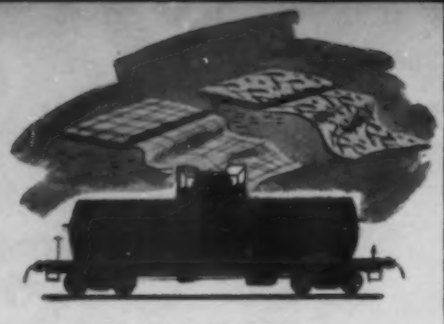
KYS-ITE

Preformed Plastic Combining Long-Fibered Wood Pulp and Synthetic Resin

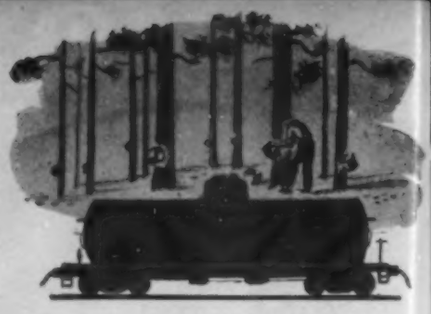
*Trademark Reg. U. S. Pat. Off.



ALCOHOL
Clean, steel car, 6,000 to 10,000 gallon capacity.



CAUSTIC SODA
Heavily insulated steel car, with or without heater coils, 8,000 or 10,000 gallon capacity. Usually specially lined.



TURPENTINE
Clean steel car; 6,000 to 8,000 gallon capacity.

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Tank car transportation of liquids in bulk, pioneered by General American has proved its versatility, its efficiency, its economy.

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If your problem is the transportation of liquids in bulk, let the nearest General American office help you.

GENERAL AMERICAN TRANSPORTATION CORPORATION

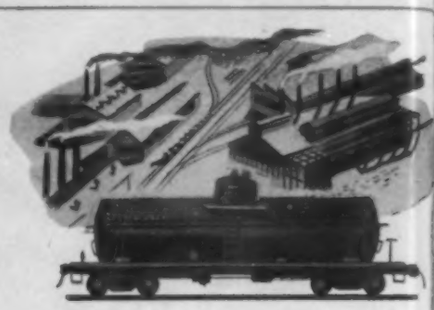
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FUEL OIL
Steel car, steam coiled, 8,000 to 12,500 gallon capacity.



MURIATIC ACID
Car lined with pure or synthetic rubber; 8,000 to 10,000 gallon capacity.



GASOLINE
Clean car, 6,000 to 12,500 gallons; single or multiple compartment



COCONUT OIL
Clean steel car, with steam coils, usually 8,000 gallon capacity.



TANNIC ACID
Equipped with brass coils and interior lined with a resinous, plastic or asphaltic material.

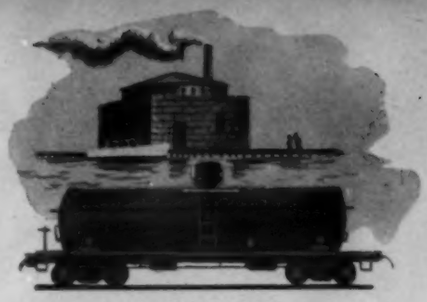


MOLASSES
Steam coiled car with heavy capacity trucks; 8,000 gallon capacity.



CORN OIL

Clean, steam coiled car.



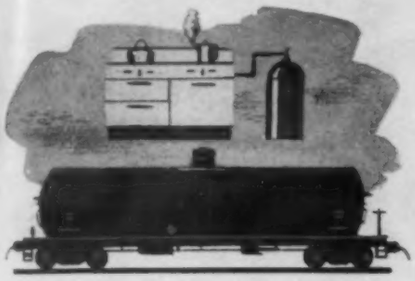
CHLORINE

Insulated, welded car; built to withstand pressure up to 500 pounds; 15 or 30 ton capacity.



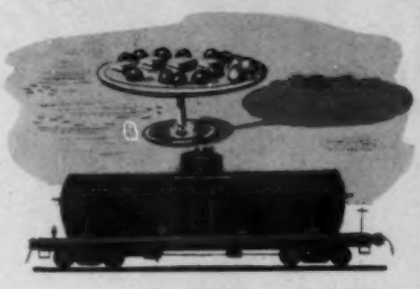
COTTONSEED OIL

Clean, steam coiled car of 8,000 gallon capacity.



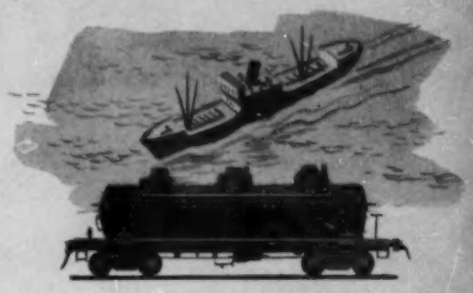
PROPANE

Heavily constructed car, welded and insulated. Built to withstand internal pressures to 300 pounds. Capacity 10,000 to 11,000 gallons.



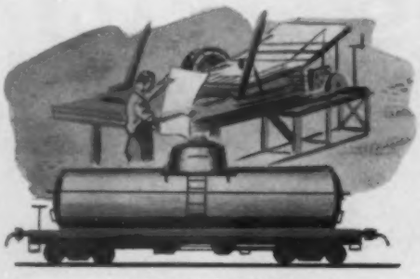
CORN SYRUP UNMIXED

Clean, steam coiled with heavy truck capacity. Usually lined with aluminum paint.



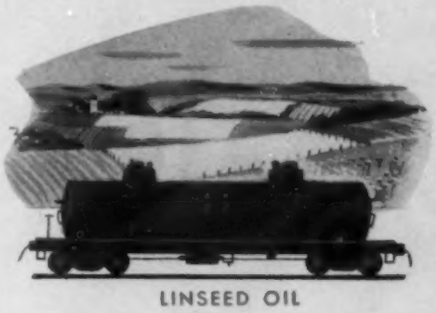
LUBRICATING OIL

Steel car, with steam coils, single or multiple compartment; usually 8,000 gallon capacity.



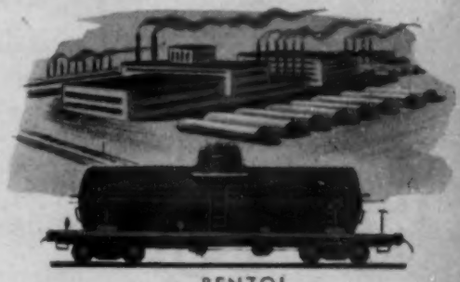
ACETIC ACID

Aluminum Car, 8,000 or 10,000 gallon capacity.



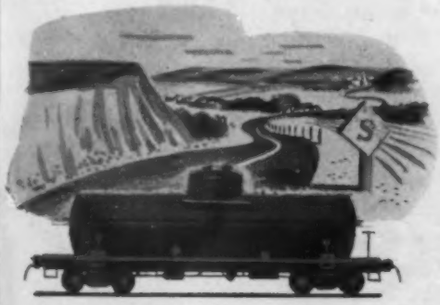
LINSEED OIL

Steel car equipped with steam coils; single or multiple compartment, usually 8,000 gallon capacity.



BENZOL

Clean car, with steam coils; 8,000 to 12,500 gallon capacity.



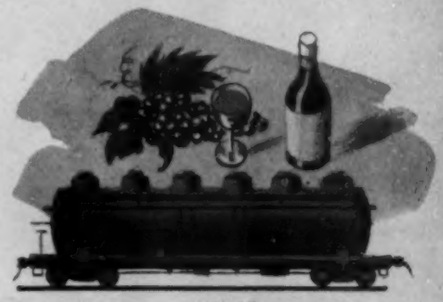
ASPHALT OR TAR

Heavily steam coiled car; with 2 or more inches of insulation; steam jacketed outlet; 8,000 to 10,000 gallon capacity.



LARD

Clean steam coiled car, usually of 8,000 gallon capacity



WINE

Insulated car with one to six compartments. Interior coated to preserve quality.



TUNG OIL

Steam coiled steel car, usually of 8,000 gallon capacity.



SULPHURIC ACID

Heavily constructed steel car with heavy truck capacity. Equipped to unload through dome.

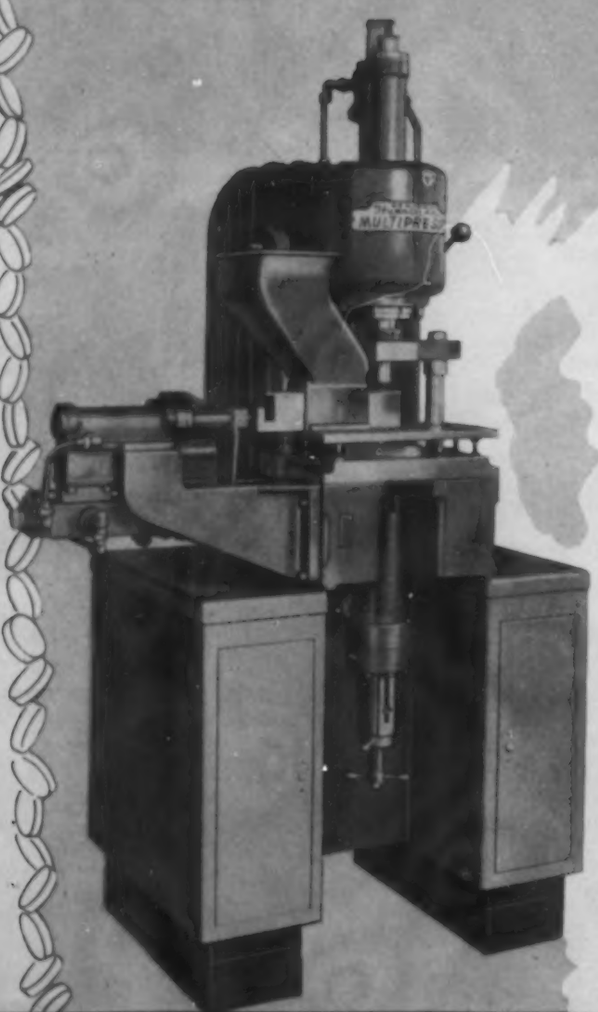


FISH OIL

Steel car with steam coils.

PELLETING
is another "natural" for
MULTIPRESS





REPORTS from users show that MULTIPRESS has a lot to offer on a wide variety of pelleting operations — particularly in the production of ceramic parts, small powdered-metal compressions, plastic preforming pellets, and the pelleting of chemicals for reaction-tower research.

Exact pressure control, a feature of MULTIPRESS, means that each piece of work is formed with the *exact* pressure shown by experimentation to be best for the job.

Multi-speed ram control makes it possible to regulate the speed with which the punch enters the die. This permits *gradual* compacting of the loose material, better air exclusion from the die fill, more uniform density of the finished part.

Vibratory Ram Action, another MULTIPRESS achievement, permits a series of short, high-speed, uniform strokes that compact the die fill in progressive pressure applications. On some materials, this vibratory action brings marked advantages — higher density, greater uniformity, better particle orientation, improved air escape, etc.

For pelleting *and scores of other jobs*, the amazingly compact, bench-size MULTIPRESS offers many operating advantages that set new production standards. It is built in 4, 6, and 8-ton sizes, in a variety of models, and offers a wide range of standard toolings and accessories. Write for complete details today.

DENISON
EQUIPMENT for APPLIED
HydrOILics

THE DENISON ENGINEERING CO.
1176 DUBLIN ROAD, COLUMBUS 16, OHIO

WRITE FOR THIS *New* CATALOG



THE NE line of Rubber & Plastic processing equipment is covered in this 36 page catalog. Many new specialized machines developed to meet war production demands are shown. Triple Stage Extruders covered by separate folder—ask for it along with catalog if interested. Request on company letterhead please.

NATIONAL ERIE CORPORATION

Erie, Pa. NE U. S. A.



Whether it's Bicycle riding in Ireland ... or ...



Doing the Ironing in China,

you will Find
WHITE PLASTICS
Products



MODERN IRON HANDLE



BICYCLE HEADLIGHT
GENERATOR HOUSING



Reputation for Achievement

- Mold Making
- Precision Molding
- Product Development*

*Patent Holders and Inventors—we maintain Engineers and Designers to help you develop and assist you in financing your ideas into products. Inquiries or consultations involve no obligation.

Thos. J. WHITE PLASTICS Company
SAINT LOUIS 22. MISSOURI

DESIGNED TO THE PLASTICS INDUSTRY'S REQUIREMENTS

THE NEW G-E PLASTICS PREHEATER



5 Kw, 40 Megacycles . . . for Faster Preheating*

Here are the requirements that a leading plastics manufacturer prescribed for an *electronic* plastics preheater:

- *FAST HEATING*
- *SIMPLIFIED OPERATION*
- *STURDY CONSTRUCTION*
- *MINIMUM FLOOR SPACE*
- *EASY MAINTENANCE*
- *PORTABILITY*
- *AUTOMATIC COVER*
- *TWO TIMERS*

G.E.'s new plastics preheater is designed to meet all these requirements. Its 5-kw output and 40-megacycle operation (by means of a watercooled oscillator tube) provide faster heating, stepping up production. With a sturdy construction for heavy-duty industrial use and accessibility for easy maintenance, repair costs are kept down—its compact design ($49\frac{5}{16}$" h x $19\frac{1}{2}$" w x $33\frac{11}{32}$" d) and portability features permit it to be placed conveniently between two presses. And with its simplified operation and automatic cover, increased operating efficiency is made possible.

● Add up the important advantages you obtain by installing the new G-E preheater in your shop: Accelerated Production + Low Maintenance + Greater Operating Efficiency = *Increased Plastics Production at Lower Unit Cost.*

There's a heating specialist located in a G-E Office near you. He will be glad to supply you with information on this new preheater, as well as advise you on the selection of electrical equipment for all types of heat-treating processes. Or, mail the coupon below.

* For example, this new preheater will heat one pound of wood-flour phenolic compound from 70° F to 250° F in 12 seconds.

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY,
Sec. 675-136
Schenectady 5, N. Y.

.....Please send me Announcement GEA-4623, which describes the new fast-heating 5-kw Electronic Preheater.

.....Please have a heating specialist contact me at the earliest opportunity.

Name.....

Company.....

Address.....

City.....State.....



TINY HEARING AID
is only 2 in. by 4 in. weighs only 5½ oz.

PAYS AN 80% SAVING

—on the "World's Smallest, Lightest Hearing Aid"



Attachment of plastic binding post could be a problem. Two Type "Z" Screws engage securely in thin aluminum case—make it simple. Two others go into and hold a laminated plastic insulator.



Eight tricky tapping and hole aligning operations avoided by using P-K Type "Z" Screws to fasten chassis to case. Screws enter through holes in case to engage in tiny brass brackets on chassis.

Here are some real fastening problems! To tap threads in the tiny brass chassis brackets and the thin aluminum case would be exceptionally difficult and costly. To accurately align holes in the case with tapped holes in chassis brackets, and then drive machine screws without frequent stripping of threads, "would be next to impossible".

Micronic Corporation's engineers claim it was just common sense to specify P-K Self-tapping Screws, and they figure it brought an 80 percent saving in fastening costs.

With these unique Screws there was no need for tapping. And, hole alignment presented no problem, because of freedom from worry about crossed threads, ability to hold the unit together while making the first fastening, and the tendency of a Self-tapping Screw to correct a minor misalignment of holes. A Phillips Recessed head was specified to avoid damaging driver skids.

Are you taking full advantage of this "short cut" method? To make sure, ask for a P-K Assembly Engineer to check your metal and plastic fastenings with you, and point out where Self-tapping Screws will do a better, cheaper job than machine screws, rivets, bolts an inserts in plastics. Or, mail assembly details for recommendations. Parker-Kalon Corp., 200 Varick St., New York 14.

P-K



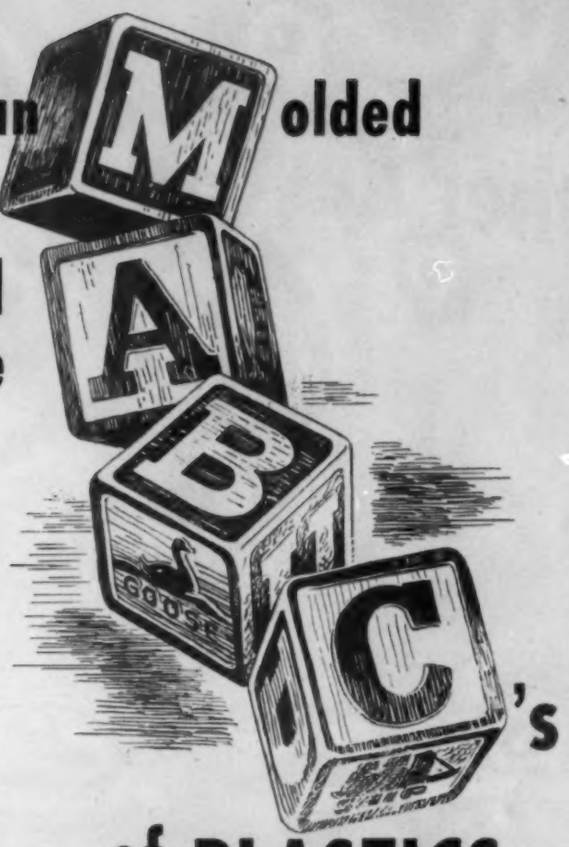
PARKER-KALON SELF-TAPPING SCREWS

FOR EVERY METAL AND PLASTIC ASSEMBLY

*Over a quarter of a Century

Long Ago*

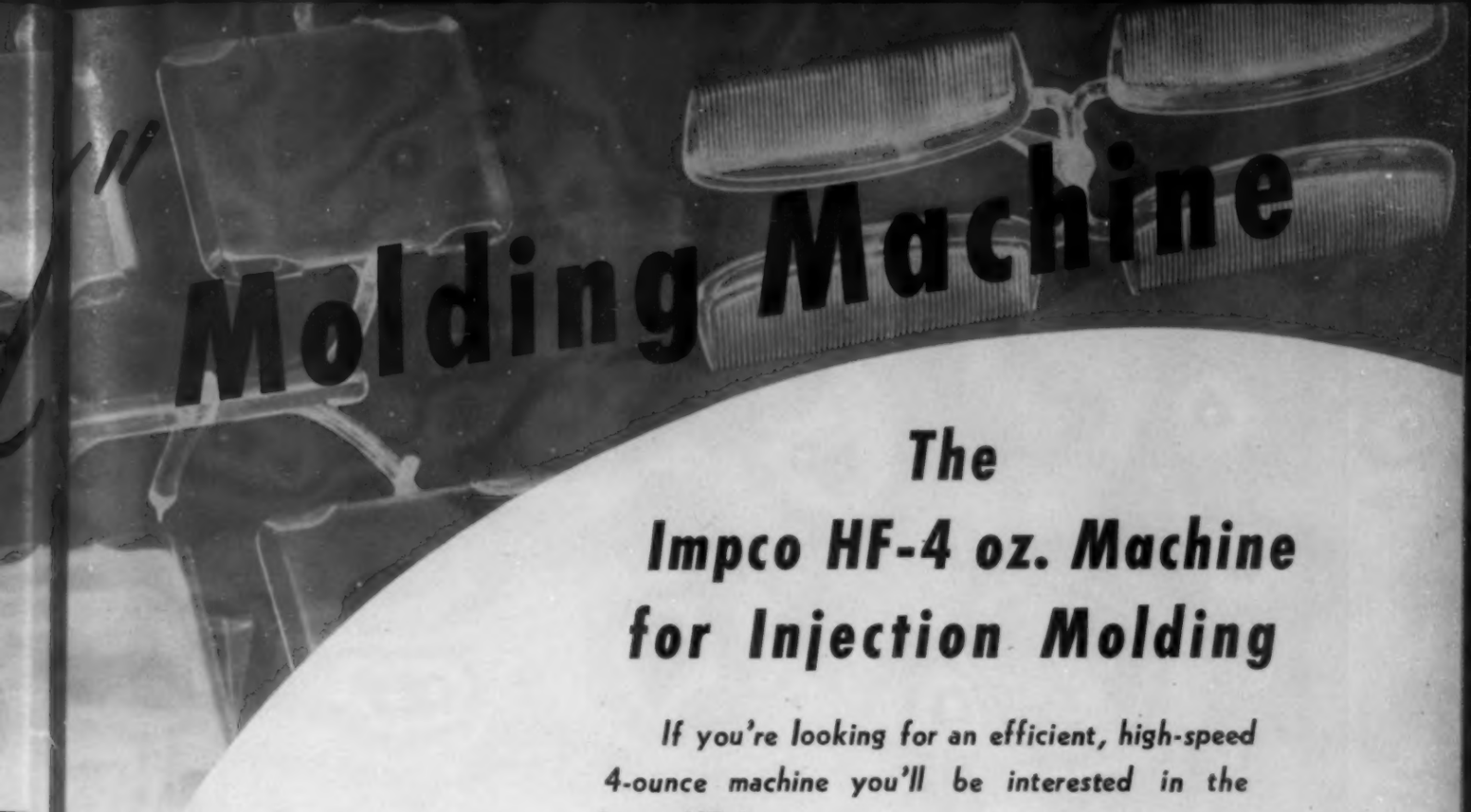
Michigan Molded Learned the ABC's of PLASTICS



Many years ago we graduated from the primary classes of the school of plastics. Today, Michigan Molded, for all its small size — indeed, BECAUSE of this modest size — furnishes a consistent, magnificent standard of quality, plus versatility, in extrusion, injection and compression! Yes, MICHIGAN MOLDED is an old-timer with visionary eyes — versed deeply in the craft of plastics, knowing, as well, how important it is to STAY SMALL in order to furnish each customer with the highest degree of attention! Today, with a vast backlog of orders, Michigan Molded is not too busy to give sincere and earnest consideration to your plastic requirements. We prosper by developing and producing new applications, and always enjoy solving new customer problems. You are assured of personalized consideration at Michigan Molded.




Another new "Improved"



Molding Machine

The Impco HF-4 oz. Machine for Injection Molding

If you're looking for an efficient, high-speed 4-ounce machine you'll be interested in the Impco HF-4.

An improved hydraulic system gives positive clamping pressure. The pressure on the clamping cylinder is held by its own pump and may be adjusted without affecting the balance of the hydraulic system.

Uniform transfer of heat to the molding material is obtained through the use of separate control units to regulate the temperature of the nozzle, center and rear portions of the heating cylinder.

All parts of the machine are accessible for easy adjustment.

These are only a few of the improvements. Write for the full story... better still... visit us in Nashua and see our complete line of molding equipment.

PLASTIC MOLDING MACHINERY DIVISION

Improved **PAPER MACHINERY CORPORATION**

NASHUA, NEW HAMPSHIRE

MP-4



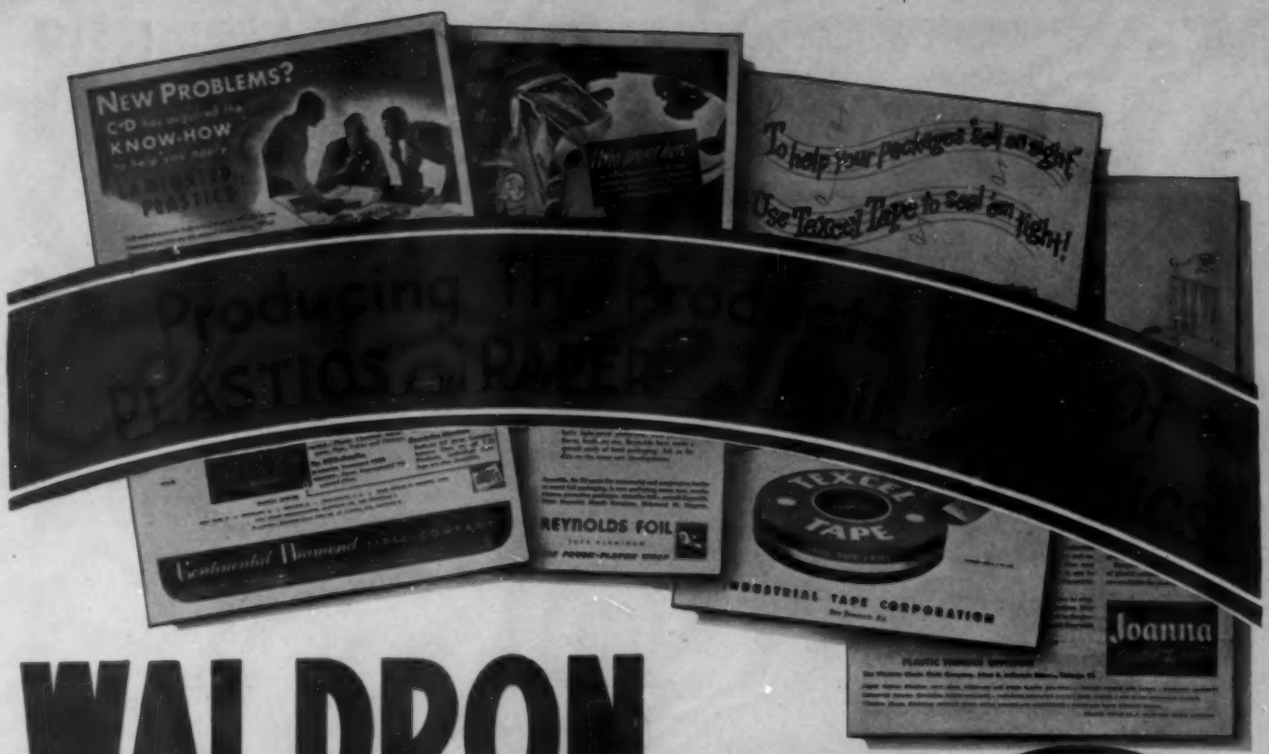
What is the Nature of your plastic design problem?



Industrial's staff of technical experts are particularly qualified to discuss problems in the development and production of your plastic product. Their experts know intimately from long experience all phases of the compression molding process. They can assist you in design, fit, finish, color and type of material. From deep draw units to shallow flat surfaces our methods produce uniformly high volume within extremely close tolerances. Whatever the nature of your design problem, Industrial's staff can help you. Write today.

INDUSTRIAL MOLDED PRODUCTS CO.
2035 W. Charleston Street, Chicago 47, Illinois

South Bend Representative: Krueger Sales & Engineering Co., P. O. Box 419, South Bend, Ind.



WALDRON *Processing* MACHINES

Part of the pictures of the many famous new products being introduced are the WALDRON machines used in their processing. Converting webs of raw stock into the hundreds of new facinating finished products is the job usually entrusted to the modern WALDRON processing machines—designed and built by an organization that knows the problems and possibilities in modern processing operations.

Our capable Research and Development Staff with complete testing equipment at its command is available for aiding development executives to determine the most efficient method of processing from raw stock to finished product. Inquiries will be treated in strictest confidence. Investigate the possibilities.



1 Waldron 6 Color Engraved Roll Printer.
2 Waldron Reverse Roll Coater.
3 Waldron Machine Line for Plastics Treating.
4 Waldron Centennial Embossing Machine.

Coating Machines
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RIEGEL-X-7

For surfacing plywood. Transparentizes under action of heat and pressure. Provides a hard, protective surface and enhances the beauty of natural wood grains.

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For surfacing of both plywood and wallboard, where it is desirable to hide the natural appearance. The hard finished surface can be painted and is highly resistant to abrasion and attack by all outside influences.

X

If papers of this type have a place in your operations, write for a copy of our technical bulletin "Papers for the Plastics Industry." Riegel Paper Corporation, 342 Madison Avenue, New York 17, N. Y.

X

RIEGEL-X

A group of impregnated papers for surfacing, for molding and for high or low pressure laminates.



Sure cure for housing problems:

. . . boost output 169%

High-powered cost cutting makes a strong case for any industrial process, and dielectric heating did just that when it sent production soaring 169% in this plastics operation.

The old way of producing heavy-sectioned motor housings involved molding powders in a two-cavity mold. But this required a 10-minute cure, limiting production to 130 pieces per day. Demand for a doubled output required another $12,000 mold (plus 14 weeks' waiting) and, in addition, the use of a second press.

The new way simply switched powders to preforms and preheated them with a standard Westinghouse 5-kw, r.f. generator. Results: curing time was slashed from 10 minutes to 3 minutes and production of the two-cavity mold rose from 130 units per day to 350 . . . a 169% boost!

Better yet, holes once drilled in the housing could now be molded since the new uniform plasticity reduced breaking strain on the mold pins.

This is just one example of the way dielectric heating does an effective, profitable job for the plastics industry. Ask your nearest Westinghouse office today for the full story. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-02074



HERE'S FREE HELPFUL INFORMATION

on both induction and dielectric heating . . . their principles and theories; where to use them; how to select them; actual case histories of their use. Write for your copy today, on your business letterhead, please. Ask for B-3620.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

TRAINING

in step with

INDUSTRIAL TRENDS

Plastics Institute training is predicated upon two basic principles:

A. Thorough study of accepted practices and materials.

B. Evaluation of current problems, new materials and new techniques.



For example, here are

THREE TYPICAL CASTING ASSIGNMENTS

Casting of Phenolic Resins Industrial and decorative applications of cast plastics are prominently featured in student projects. Each student is given opportunity to prepare his own molds and castings.

Slush Casting of Thermoplastic Granules Various techniques of slush casting thermoplastic granules are taught. Attractive, light colored hollow-walled objects can be prepared in a relatively short time.

Imbedding of Specimens in Transparent Plastics The imbedding of articles in transparent plastics has captured the interest of many students. Preservation of botanical specimens offers a field of activity which benefits from this unusual casting procedure.

In addition to casting, other phases of plastics thoroughly covered at Plastics Institute include: Mold design, high-frequency pre-heating, fabrication and lamination. Testing methods and molding practices are taught on equipment of the type used in the industry.

Your inquiries regarding both the Home Study Training and Resident Technology courses are welcomed.

APPROVED FOR VETERANS

Plastics
INDUSTRIES TECHNICAL INSTITUTE

Francis A. Gudger, President John Delmonte, Technical Director

WRITE DEPT. MP6-9

NEW YORK- 122 EAST 42ND ST. • CHICAGO- 221 NORTH LASALLE ST. • LOS ANGELES- 1601 SOUTH WESTERN AVE.

VETERANS as well as CIVILIANS now training with Plastics Institute, upon graduation, are qualified and worthy of your consideration for employment in the various branches of the plastics industry. Write to the nearest branch of Plastics Institute stating your requirements. We will endeavor to select a graduate best qualified to meet your needs.

ROBOTS AT WORK



"Robots At Work" is a 30-minute color and sound 16 mm. motion picture photographed in full color Kodachrome, with narration by Lowell Thomas. It had its premier at the National Plastics Exposition in New York—has been previewed by only a few selected groups.

This film tells the story of compression molding, from hand to completely automatic production methods. It shows typical pieces and cost studies on parts suitable for automatic molding—points out why and when this is the most economical method for molding many different parts. It shows automatic closure presses producing thousands of bottle caps per hour. Installation "shots," equally impressive, are shown from various plants.

"Robots At Work" is new, colorful, instructive, entertaining—and prints are now available, loaned for showing before company groups, technical societies, engineering schools and colleges.

Write for a booking and please give choice of two or three dates if possible.

F. J. STOKES MACHINE COMPANY
5934 Tabor Road, Philadelphia 20, Pa.

The Story of

COMPLETELY AUTOMATIC PLASTICS MOLDING

- **NEW 30-MINUTE 16 MM. SOUND FILM**
- **IN BRILLIANT KODACHROME**
- **NARRATED BY LOWELL THOMAS**



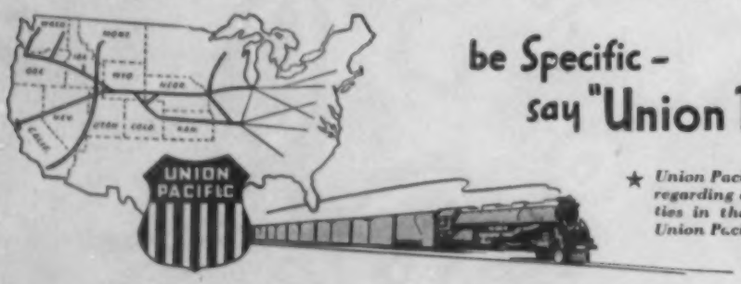
F.J.Stokes **MOLDING EQUIPMENT** FJS Est. 1895



WITH the coming of the railroads, the western frontiers were conquered. They brought men, implements for building homes and towns, transportation for marketing products. Then factories were built. And industries thrived where railroads paved the way.

In the 13 great states served by Union Pacific, there still is land to be tilled, minerals to be unearthed, livestock to be raised, room for new homes and industrial expansion.

Union Pacific will continue to serve the territory it pioneered, by providing efficient, dependable, safe transportation for shippers over the time-saving Strategic Middle Route.

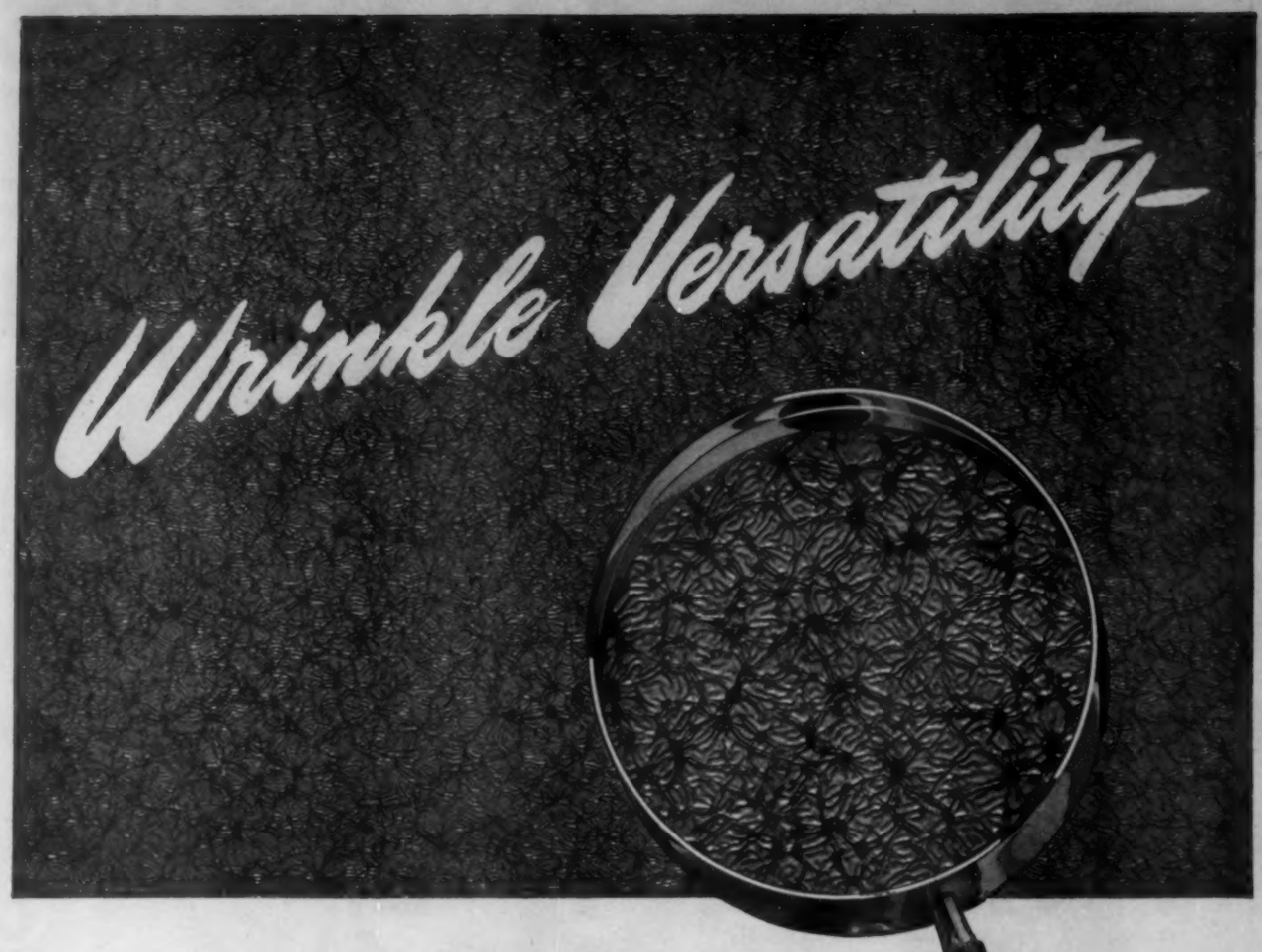


be Specific –
say "Union Pacific"

★ *Union Pacific will gladly furnish confidential information regarding available industrial sites having trackage facilities in the territory it serves. Address Industrial Dept., Union Pacific Railroad, Omaha 2, Nebraska.*

UNION PACIFIC RAILROAD

The Strategic Middle Route



means combinations of colors, too!

Wrinkle coatings are available in any colors you want—in primary colors, tints, pastels and *combination* effects for unusual eye appeal. Wrinkle versatility doesn't stop there. Users find, for example, that Wrinkle is used on *flexible* materials with the same success as on metal or similar surfaces.

Wrinkle is economical to use, requiring only one top coat. It covers imperfections in castings and weldments without extensive clean-up necessary with smooth finishes. Wrinkle protects while it enhances the beauty of coated surfaces. It doesn't chip or peel and is extremely durable even under adverse conditions.

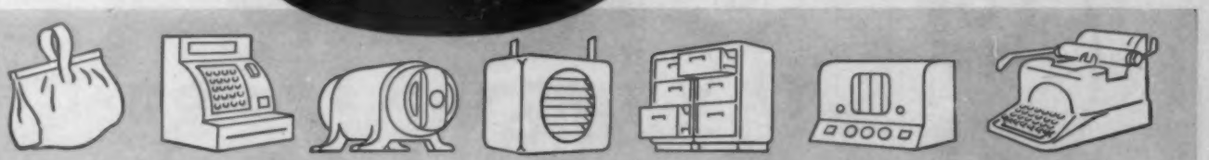
Approximately 200 leading paint and varnish plants which manufacture Wrinkle under our license can supply you with Wrinkle coatings in a variety of textures, patterns, and colors to suit your needs.

Write for "New Wrinkles in Finishing," a bi-monthly report on developments in the Wrinkle field.

New Wrinkle, Inc.,

Wrinkle
REG. U. S. PAT. OFF.

Offices and Research Laboratories
1765 Springfield St., Dayton 3, Ohio



THE "STANDARD ANSWER" TO VARIED FINISHING NEEDS

THE THERMALL CHAMP

Heats. 6 Pounds (96 ozs.) in ONE MINUTE

That's Performance in Preheating Equipment

Whenever you see the THERMALL Diamond on an HF Heating Unit, you can bet your last dollar on the *utmost in performance.*

We'll gladly give you technical and engineering data about every size THERMALL Unit. Users say that we are conservative in our power ratings. They tell us that THERMALL HF Heating Units consistently deliver more than rated power; preheat faster than we claim.

Time after time, users have said they were "amazed at THERMALL *performance.*"

If you have a pre-heating or molding problem of any kind and want technical advice or assistance—write us. We will assist you by assigning one of our technical representatives to your problem without obligation.

When you want a job done day in—day out, remember that

THERMALL *means* PERFORMANCE



The **THERMALL CHAMP** occupies only 20 x 30 inches of your floor space. Heats 96 ounces compound to molding temperature in 1 minute. Completely portable.



Bulletin M gives specifications and details of all THERMALL HF Units. It's free, on request.

W. T. LA ROSE & ASSOCIATES

635 Second Avenue Troy, New York

Representatives in All Principal Cities

Export: Omni Products Corp., 40 East 34th St., New York 16, N. Y.



WHAT'S YOUR PLASTICS PROBLEM?

THERE is hardly a manufacturer in business today who is not concerned, in one way or another, with plastics.

Perhaps it's some functional item such as a handle or a knob. Or, maybe, it's a decorative merchandiser such as a container. Then again, it may be a housing of some sort. In any case, if it's a question of plastics, bring your problems to Norton.

For more than twenty years Norton has been serving industry on an ever-increasing scale. Now there's scarcely an industry group existing for which Norton does not mold some type of plastic item. Note illustration above.

In addition to the extensive facilities for injection and compression molding which are available at Norton, the customer further benefits from the wealth of successful product development experience which makes up the background of our design engineers . . . *an important "extra".*

So whatever your plastics problem may be, send it along with all the details to Norton Laboratories, Inc. In this way, you can be absolutely sure of competent counsel and immediate action. Norton Laboratories, Inc., Lockport, N. Y. *Sales Offices: 347 Fifth Avenue, New York City; 9 South Clinton Street, Chicago.*

NORTON *Laboratories, Inc.*

COMPRESSION AND INJECTION MOLDING

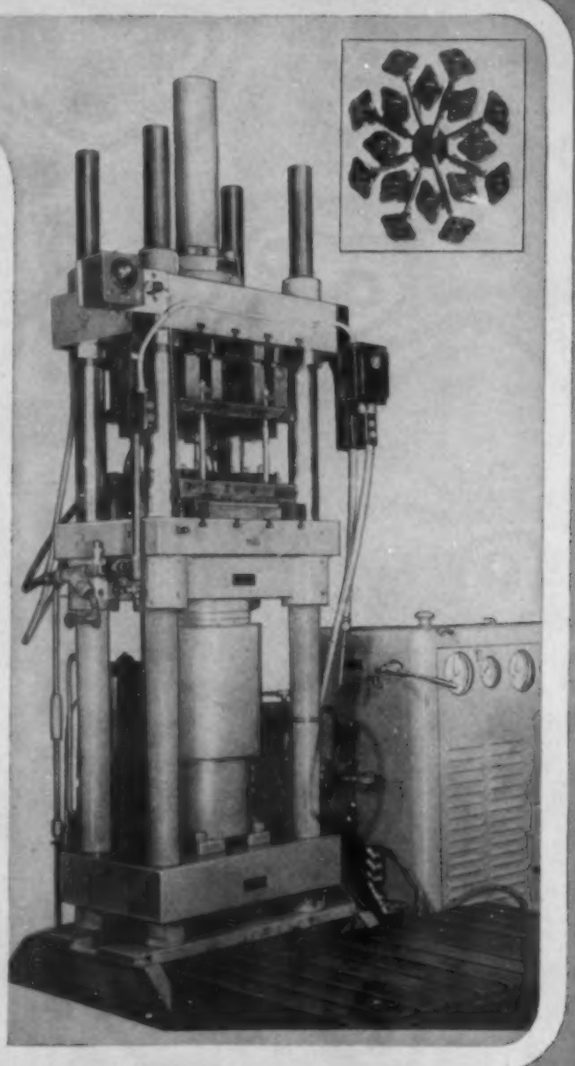
10 PRESSES OPERATE ON ONE 20 H. P. COMPRESSOR

The Transfer molding press shown at right is designed to take full advantage of the several economies resulting from using Transfer molding.

The lower clamping ram and the top Transfer ram are operated by compressed air. Ten of these simple presses will operate from a twenty horsepower air compressor at molding speeds far in excess of those obtainable by other molding processes.

Shown in the inset is a cluster of sixteen general purpose phenolic sockets that were molded in this press on a fifty-five second cycle. Other important results from the use of Transfer molding are: reduced finishing and mold maintenance expense, lower original mold cost and best electrical properties.

Many manufacturers are now producing special presses for Transfer molding. Shaw Insulator Company engineers can tell you how to design molds for them.



SHAW

SHAW INSULATOR COMPANY

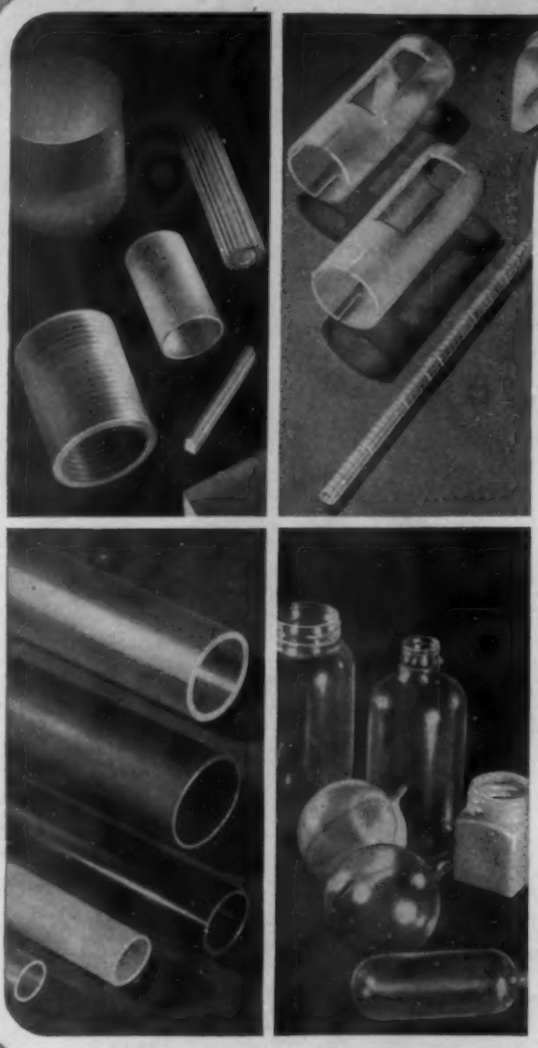
160 COIT STREET — QUALITY MARK ON MOLDED PLASTICS — IRVINGTON 11, N. J.

PLASTICS LITERATURE AVAILABLE

When your production plans call for thermosetting plastics, the logical first move is to consider Transfer molding. A list of licensed Transfer molding companies in your vicinity will be furnished promptly upon receipt of your request. Choose one — and allow him to work closely with your engineers and designers for best results.

To learn more about the specific advantages of Transfer molding, write Shaw. Engineering help in the form of bulletins and technical articles will be gladly sent you. Between the resources of Shaw and the Plax Corporation, Hartford 5, Conn., you can obtain assistance in almost all plastic methods and materials.

UNIQUE PLASTIC ITEMS FROM PLAX



From delicate fibers and thin films, to six-inch cylinders and intricately machined parts, Plax is a good source for unique plastic items. Several of the things available from Plax are original Plax developments.

"Extrusion Blowing of Thermoplastics", "How to Form Plax Polystyrene Rod", "How to Polish Plax Polystyrene Products", and "Die-Cut Parts from Plax Polystyrene" are among the interesting bulletins which have been issued by Plax and which are available upon request.

For illustrated literature on properties, prices and application suggestions for Plax plastic products, please write Plax.

PLAX SPECIALTIES

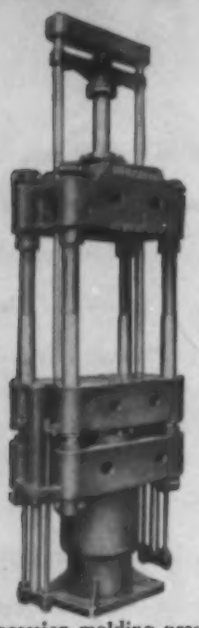
Polystyrene, Polyethylene, Methacrylate, Cellulose Acetate, and Cellulose Acetate Butyrate are among the other materials produced by Plax in the following forms: Rod, Tube, Sheet, Slab, Film, Fiber, Special Extruded Shapes, Blown Items, and Machined Parts. Not all materials are available in all forms listed.

Between the resources of Plax and the Shaw Insulator Company, Irvington 11, N. J., you can obtain help and counsel in the use of most plastic materials and processes. For interesting literature on the materials listed above . . . write Plax.

PLAX
FOR PLASTICS
NOT SUBSTITUTES···IMPROVEMENTS

133 WALNUT STREET ★ HARTFORD 5, CONNECTICUT

MOLDED PLASTIC PARTS
PLASTIC SHEETS, TUBES & RODS



• Compression molding press with overhead cylinder for ejecting and for operating transfer platen, ranging in ram sizes from 5" to 18" diameter and up.

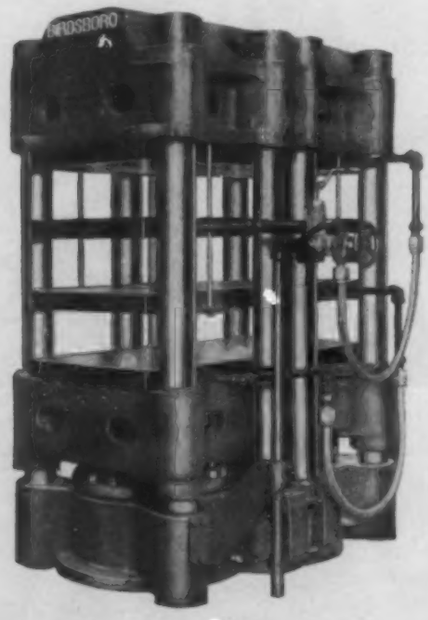
BIRDSBORO HYDRAULIC

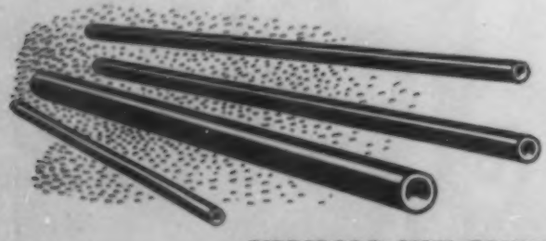
• Together these two Birdsboro Hydraulic Plastic presses are representative of a variety of available designs of presses for compression molding and laminating work.

Consult Birdsboro on your post-war requirements regarding all types of hand-operated or automatic compression molding and laminating presses. Write us today.



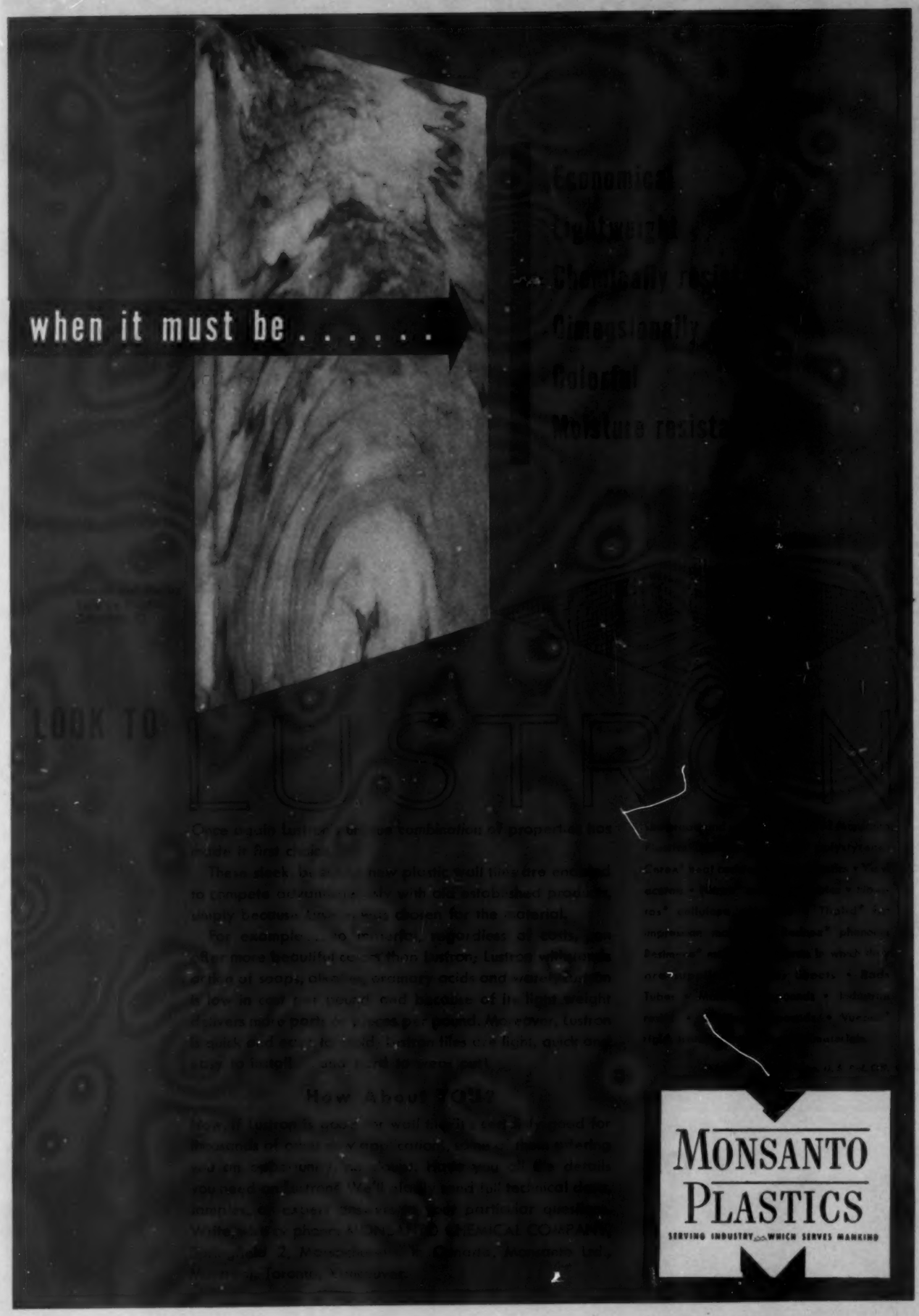
• Steam platen presses for laminating work, ranging in sizes having 12" x 12" to 50" x 110" platen areas.

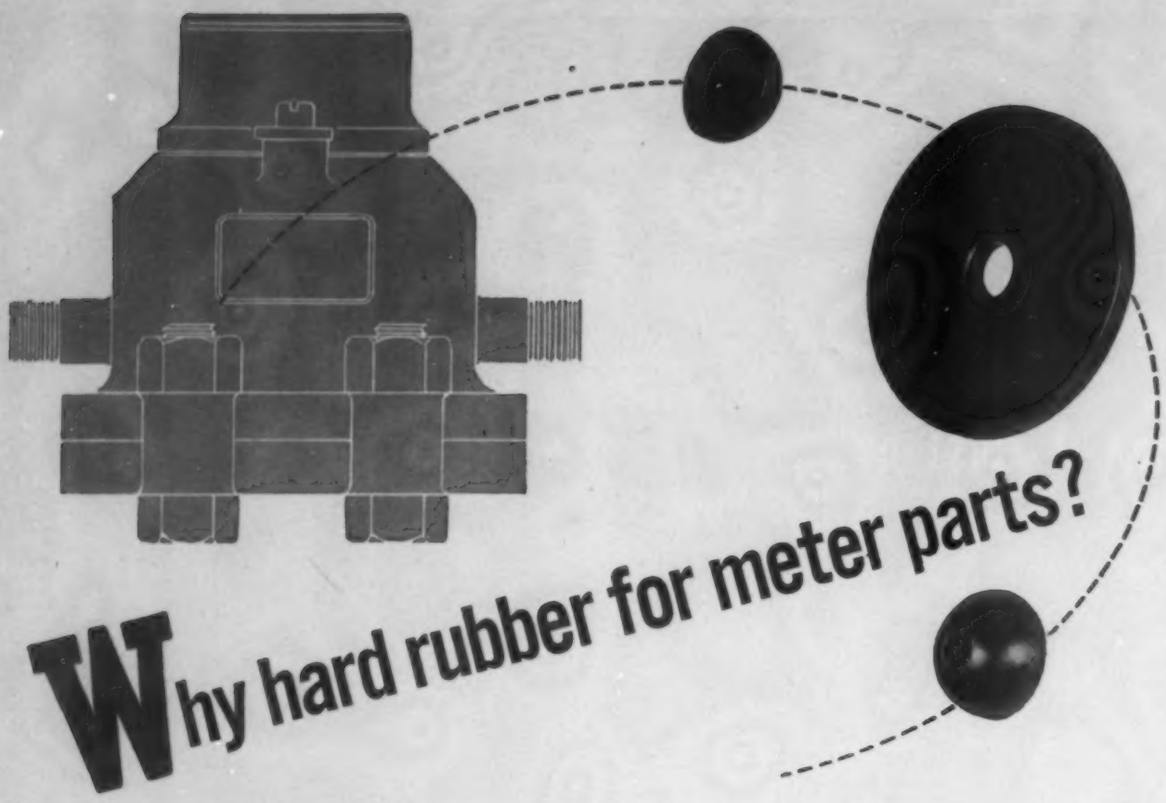




BIRDSBORO STEEL FOUNDRY & MACHINE CO., BIRDSBORO, PA.

BIRDSBORO
HYDRAULIC PLASTIC PRESSES


when it must be . . . . . .
LOOK TO LUSTRON
MONSANTO
PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND



Why hard rubber for meter parts?

The reasons so many water meter manufacturers use hard rubber may lead you to the solution of one of your design or production problems

Of all the plastics, hard rubber is the most nearly waterproof. It maintains dimensional stability remarkably well in the presence of moisture and most solvents. In addition, hard rubber is easily machined.

So far, none of the newer plastics has the over-all properties needed for applications like this. However, since we have research and manufacturing facilities for both rubber and the other plastics, our laboratories test new developments in each. Thus, we are always in a position to give our customers better materials as they appear.

We manufacture a diversified line of custom-made hard rubber parts to meet the specific design and performance requirements of meter manufacturers. With our specialized knowledge in this field, backed by over 60 years of molding experience, we can offer meter manufacturers efficient engineering service and manufacturing facilities ranging from mold design to quality controlled fabrication.

Do you need a lot of something like a meter part?

(or a knife handle? — see our ad in Modern Plastics for July)

If you are planning or using large quantities of a product that approximates these meter parts in size, shape, physical and chemical requirements . . . or something which may gain added appeal from that certain satisfying "heft" and "feel" of hard rubber . . . chances are that our experience and facilities for efficient large volume production will enable us to fill your needs at reasonable cost.

Might be worth exploring.



VULCANIZED RUBBER AND PLASTICS COMPANY

formerly . . . The Vulcanized Rubber Company

Manufacturers of Rubber and Molders of Plastics

General Offices: 4 East 29th Street, New York 16, New York Works: Morrisville, Pa.

Let SPEED NUT USERS TELL YOU WHY . . .

They Changed to SPEED NUTS

ASSEMBLY ADVANTAGES

- Reduce assembly time
- Eliminate lock washers
- Will not "clog" with paint
- Will not "freeze" to threads
- Save handling of material
- Perform multiple functions
- Weigh less
- Prevent vibration loosening
- Protect fragile materials against damage

TAPPAN STOVE COMPANY
MANSFIELD, OHIO

June 1, 1943.
Dict. 5/31/43.

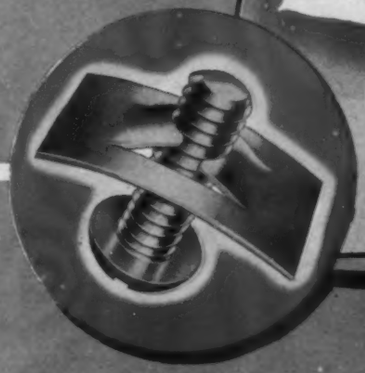
Tinnerman Products, Inc.,
2038-2046 Fulton Road,
Cleveland 13, Ohio.

Attention: Mr. George A. Tinnerman.

We are definitely and permanently addicted to Tinnerman Speed Nuts for the following reasons:

Speed Nuts are a great timesaver in assembly because they are so easy to apply, even in corners and other closely confined spaces. Each Speed Nut, whatever type, is self-locking, thereby saving the cost of a lock washer and the time handling the washer. * * * Speed Nuts have been used in our Assembly Department for more than ten years and we find more and more applications for them as the years go by.

Yours very truly,
THE TAPPAN STOVE COMPANY
J. G. Hoff,
Chief Engineer.



Chief Engineer J. G. Hoff's complete letter lists eight reasons why he is "permanently addicted" to SPEED NUTS. But let's emphasize only two.

With SPEED NUTS the screws start easier and the nut pulls down faster, for there's no installation torque until the last few turns. No wrenches are used—only light finger pressure is necessary. What a relief when fastening parts in close quarters! SPEED NUTS also do away with buying, stocking and applying lock washers. The exclusive, spring-tension lock does a better holding job and even prevents damage to fragile materials.

From toys to trucks and airplanes, SPEED NUTS have improved the assembly of countless products and cut costs. Why can't they do the same for you? Write for test samples, describing your assembly details, for SPEED NUTS are made in over 3,000 shapes and sizes.

TINNERMAN PRODUCTS, INC. • 2048 FULTON ROAD • CLEVELAND 13, OHIO

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London
In France: Aerocessoires Simmonds, S. A., Paris
In Australia: Simmonds Aerocessories, Pty. Ltd., Melbourne

Speed Nuts
PATENTED
* Trade Mark Reg. U. S. Pat. Off.

THE FASTEST THING IN FASTENINGS



Crystal detector–1946 model

Remember the crystal detector in the first radios – hunting for the right spot with a cat's whisker? For years the detector lay discarded in favor of the vacuum tube. But when microwaves came, and with them the need to convert minute energy to amplifiable frequencies, a Bell Laboratories' scientist thought back to the old crystal.

Silicon of controlled composition, he discovered, excelled as a microwave detector. Unlike the old-style natural crystals, it was predictable in performance, stable in service. From 1934 to Pearl Harbor, the Laboratories developed silicon units to serve microwave research wherever needed.

Then Radar arrived. The silicon crystal came into its own, and found application in long-distance microwave Radar. Working with American and British colleagues, the Laboratories rapidly perfected a unit which the Western Electric Company produced in thousands. It became the standard microwave detector.

Crystal detectors are destined to play a big role in electric circuits of the future. They will have an important part in Bell System microwave radio relay systems. In various forms, they may reappear in radio sets. Here again Bell Laboratories' research has furthered the communication art.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED ECONOMIES AND IMPROVEMENTS IN TELEPHONE SERVICE

Productioneering In Plastics



Productioneering, as practiced by Sommer and Adams is the simultaneous planning of product and production method, in collaboration with the producer, aiming at lowest cost with assured consistency of high quality.

YOU won't find the finest plastics processing machinery manufactured by "just anybody." It is distinctly special purpose machinery, producible only by organizations with a particular "know how" in the realm of out-of-the-ordinary production engineering.

The modern plant above houses just such an organization, The Sommer and Adams Company, with a quarter of a century of experience backing up our oft repeated claim that . . . "If it can be made automatically . . . Sommer and Adams can build you a machine to make it. . ."

Two news items about this outfit are worthy of note by Plastics manufacturers . . .

1. Sommer and Adams Productioneering Service (fitting special machines to special products) again is available to the plastics industry.

2. A new plastics production machine of unusual interest will be announced by Sommer and Adams within thirty days. It won't revolutionize the industry, perhaps, but it will prove of tremendous value to it.

In the meantime let us serve your special engineering needs.

S&A

THE SOMMER AND ADAMS COMPANY

18521 EUCLID AVENUE . CLEVELAND 12, OHIO

Custom-Built EQUIPMENT FOR MANY PURPOSES

SUBSIDIARY OF THE FEDERAL MACHINE AND WELDER COMPANY



FOR POST FORMING



FOR SHEARING



FOR PUNCHING

NEW!... "XFL"

• The Hummel-Ross Fibre Corporation announces the manufacture of a new, feather-weight stock known as "XFL", specially designed for saturating and laminating. Because of its light weight, producing extra yardage per ton, and its uniform absorbency, "XFL" is suggested for latex and plastic impregnating. The characteristics of "XFL" make it particularly suitable as a base stock for the manufacture of laminates that are to be used for Post Forming without fracture, for Shearing or Punching. Its extreme softness and flexibility make it ideal for conversion into artificial leathers.

May We Send You Working Samples and Prices?

"XFL" SATURATING

Originators • Creators

HUMMEL - ROSS

FIBRE CORPORATION

Hopewell, Virginia, U. S. A.



Only 2/3 of an ounce . . . that's all the famous "Cobra Arm" weighs! That's one big reason why records on a Zenith play so beautifully, so clearly, and without surface noise.

Zenith assured feather touch of the needle by sound design and by selecting that *No. 1 light weight material,* Lustron.

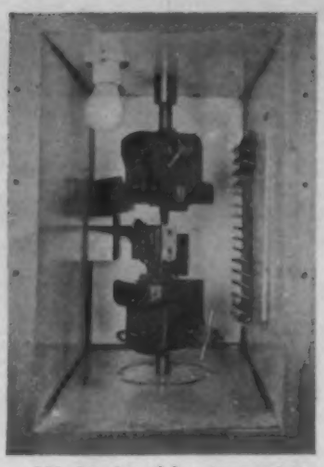
Zenith engineers knew Lustron (1.054 sp. g.) was lightest in weight among all rigid plastics . . . one-tenth the weight of usual alternatives and much lighter than so-called "light" metals (Aluminum 2.70 sp. g. — Magnesium 1.74 sp. g.).

Add to this important quality Lustron's high dimensional stability, beautiful surfaces, excellent electrical properties, uniform strength, freedom from crazing, and suitability to the newest and best molding processes . . . and you understand why Zenith uses Lustron, not only for its "Cobra Arm," but for Zenith record changers, Zenith portable radio cabinets, and other Zenith equipment.

MONSANTO PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

Does this suggest to you ways where Lustron will make or improve products in which you are interested? Full details, samples, and expert counsel are yours for the asking; address: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts. In Canada, Monsanto Ltd., Montreal, Toronto, Vancouver. *Lustron: Reg. U. S. Pat. Off.*

Sub-Zero Plastics tests at JOHNS HOPKINS University Research Laboratories *with* OLSEN PLASTIVERSAL



(A) Interior of low temperature cabinet showing sample racks and tension grips with extensometer attached.

The Laminated Plastics Test Project operated at Johns Hopkins University, in Baltimore, Maryland, has conducted over 5000 tension, compression, and flexure tests at temperatures ranging from — 100° F. to + 200° F. with the Olsen Plastiversal Testing Machine illustrated here.

This project, sponsored by National Electrical Manufacturers Association, is under the direction of Dr. Ralph K. Witt, who devised the special low temperature testing techniques shown.

The Olsen Plastiversal Testing Machine is equipped with an Olsen Electronic High Magnification Recorder which produces, in chart form, an accurate stress-strain diagram of each test made. The specimen is placed in the tension, compression, or flexure clamps, with extensometer attached — all in the temperature controlled cabinet. The machine is put in operation and every step in the physical change of the specimen during the test is transmitted electronically to and recorded on a letter size chart for permanent record and subsequent study.



(B) The cabinet front with the electrically heated gloves attached.

The high accuracy, ease of operation, and dependability of this equipment is an invaluable aid in the comparison, standardization, control, and development of plastic materials.

The Olsen Plastiversal has been designed especially to meet the needs of the Plastics industry — it is but one of a number of perfected testing instruments for both laboratory and production use. We will be pleased to send complete details on Olsen Plastics Testing Equipment — Write today for Bulletin No. 23.



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Which method of manufacture?

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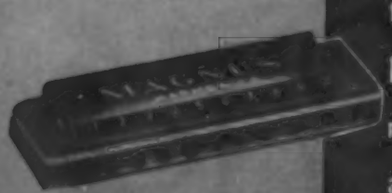
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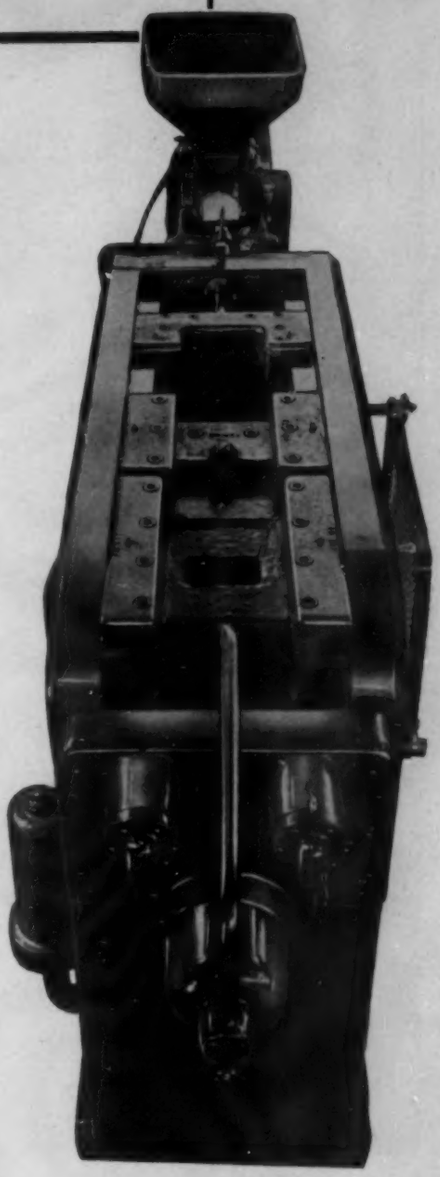
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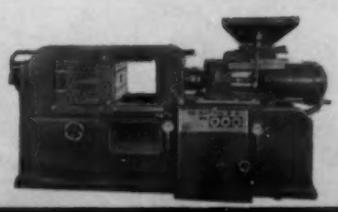
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Every ounce, every cubic inch of the DEMATTIA press counts in production. That is why this uniquely compact machine is winning new users every day among leading injection molders in America!





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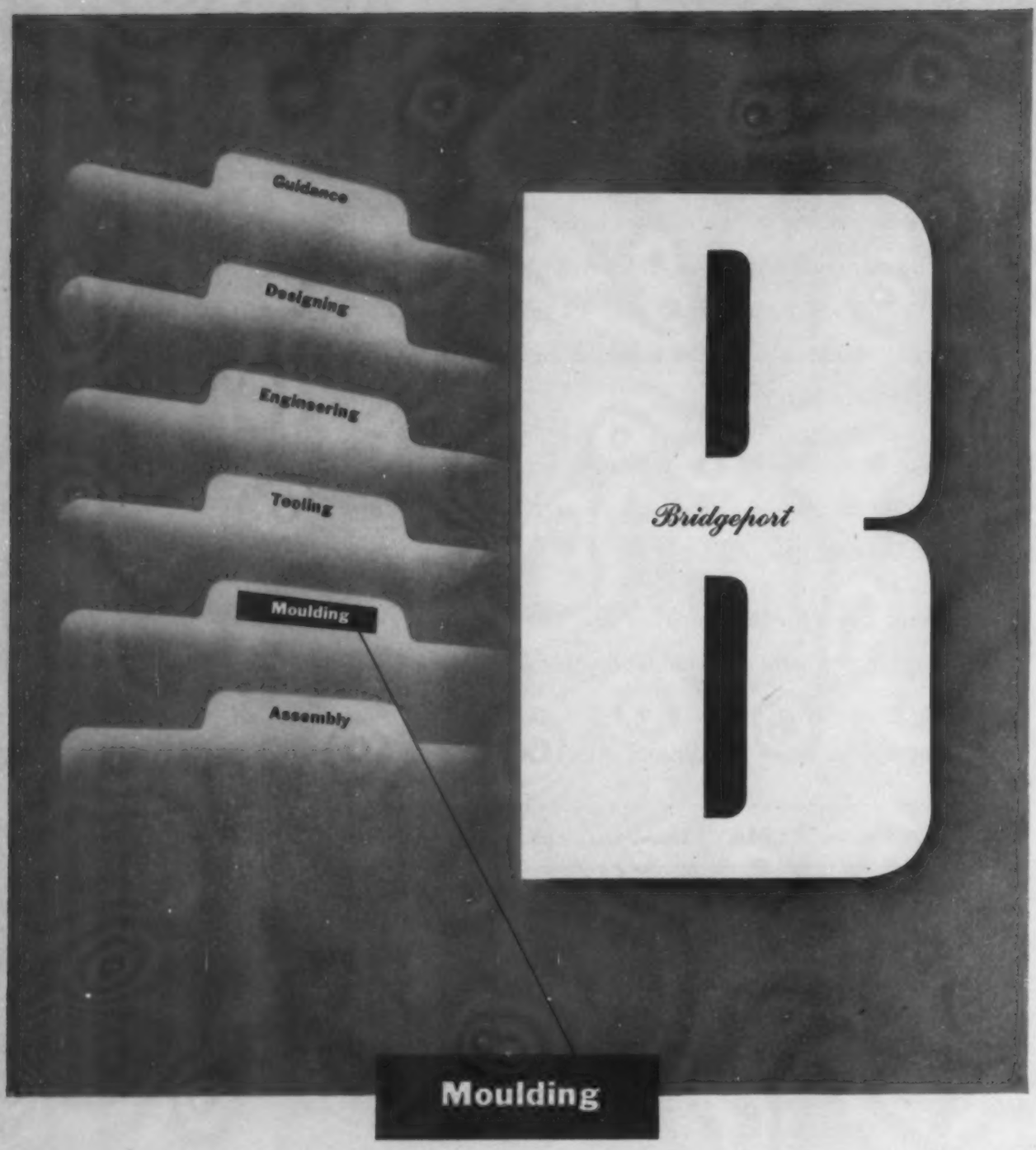
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11. Net weight 16,000 lbs. approximately.

**Above specifications refer to 12-ounce machine*

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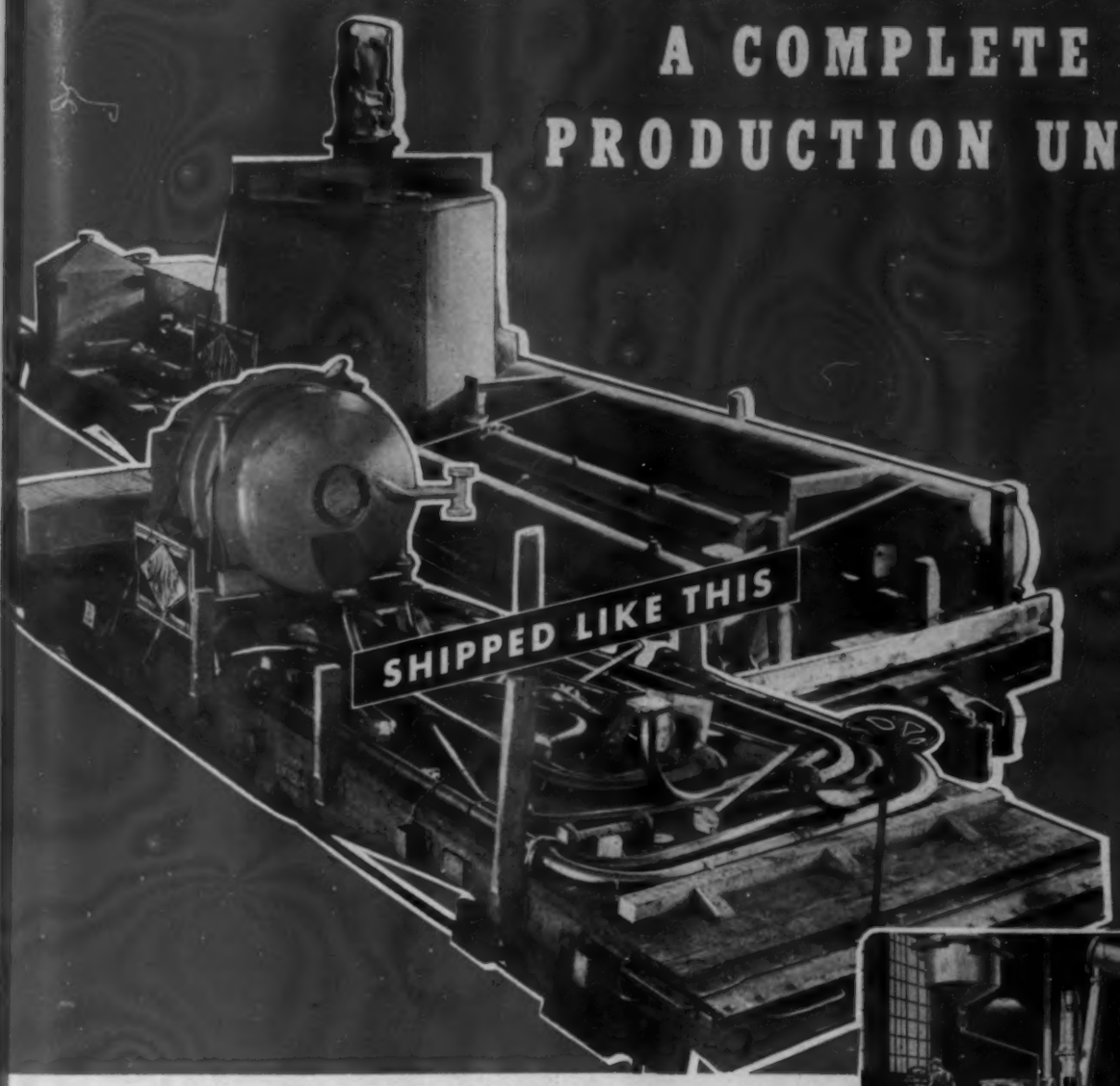


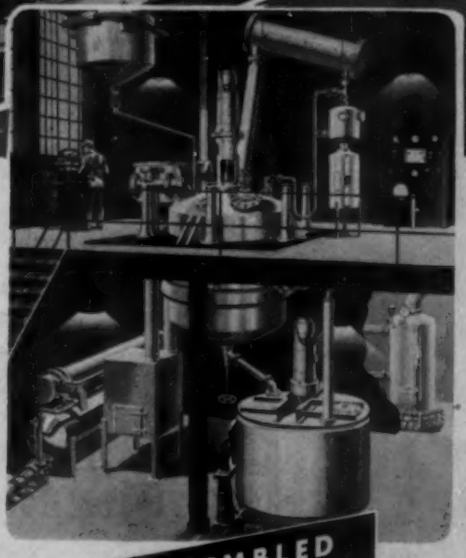
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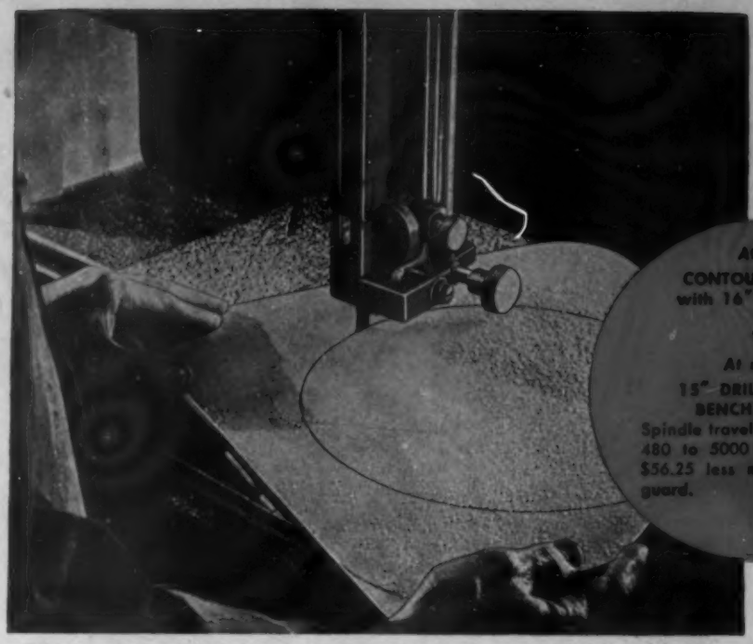
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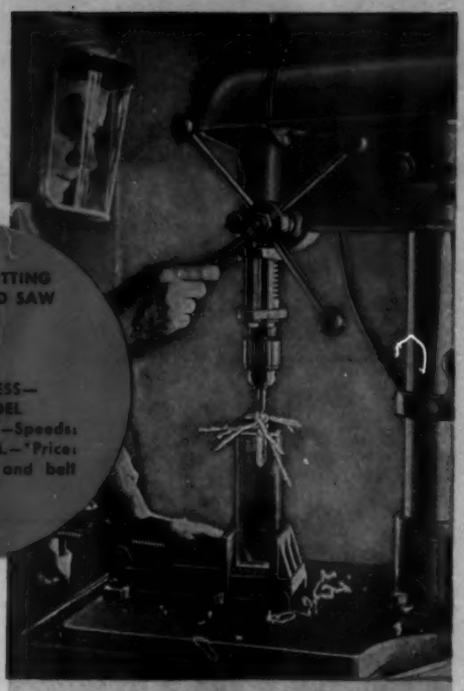
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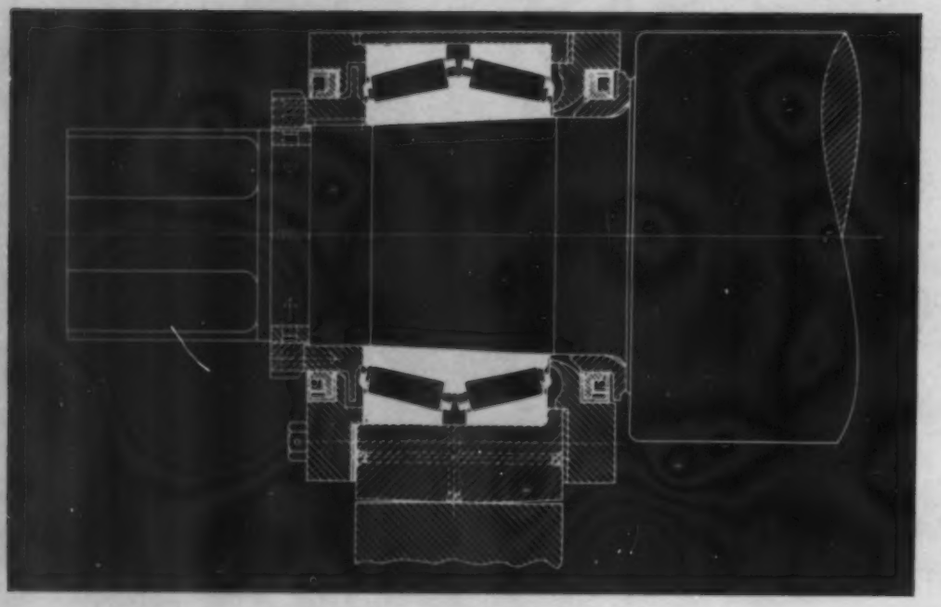
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FEATURES OF THE *Van Dorn* H-200 PRESS



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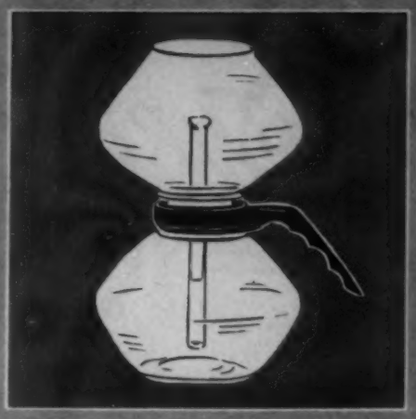
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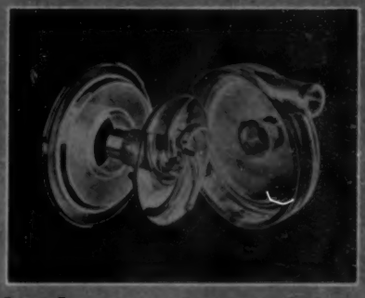
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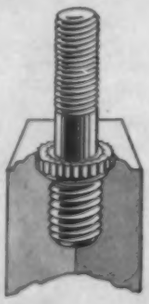
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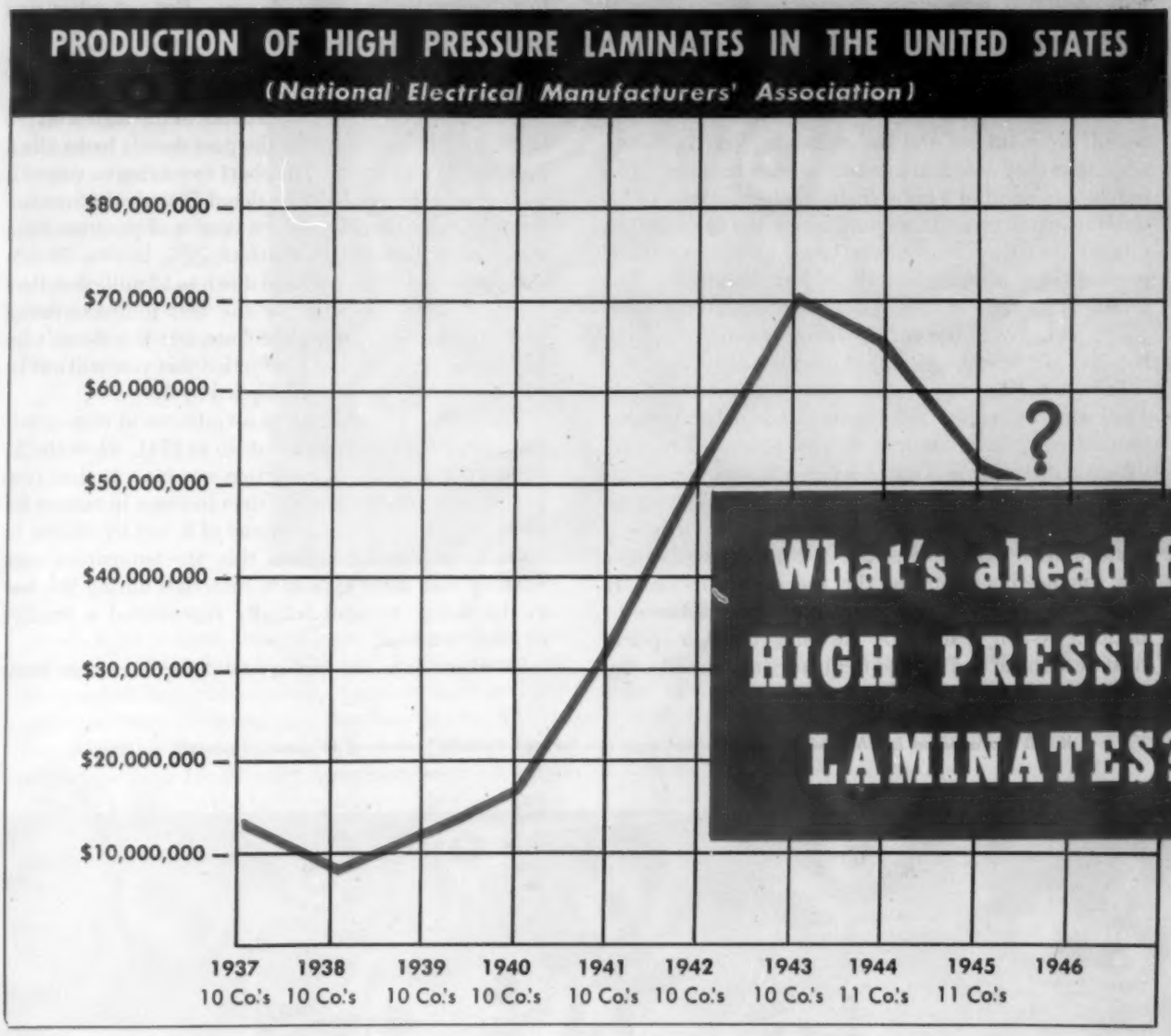
National HEADED AND THREADED PRODUCTS

Write for samples and full information on Rosan Inserts and Studs.

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

MODERN PLASTICS

VOLUME 24 SEPTEMBER 1946 NUMBER 1



THE business of punishing plastic products is getting to be a national hobby. Anybody who wants to prove to himself or to anyone else that a plastic product will stand up under normal use just naturally subjects the product to fire and sledge hammer, to acid and oil baths, to accelerated weathering and machine abrasion. Similar products made from metal, wood, glass or any other material don't get this high honor, nor this opportunity to live up to abnormal conditions in expectation of a normally useful life. Glass breaks, metal corrodes, wood splinters. So why waste time giving them punishment beyond their proven ability to take it?

But plastics are something else again. Give 'em the works! Since the day when Henry Ford attacked a soybean plastic rear compartment door with an axe for the benefit of photographers, this has been the thing to do. If the plastic material stands up to the punishment, you can generously admit that it might be pretty good, but is probably an exception. If it doesn't go far beyond the limits of its chemical and physical structure and those of competing materials, then by all means damn it roundly and accuse the plastics industry of making exaggerated claims.

Now, having tested the stuff as severely as possible, it is customary to use it with similar vicious fervor. Since it had to be better than all competing materials in order to get your interest in the first place, it should now be forced to live up to its tests by taking regular and frequent abuse. Kick it around as much as possible. Butt cigarettes on it. Pour liquor on it. Never, by any means, clean it with anything more efficient

than a half-hearted swipe of just a slightly damp cloth.

Surprisingly enough, you will find that many plastic products apparently react well to this type of abuse. Depending on your character, this will either drive you to fiendish new ingenuity in creating punishment or will cause you to respect plastics and use them properly.

Probably the most outstanding example of such glorious martyrdom is that of the high pressure laminates. These materials have stood up so well under continued assault by mankind and the elements over three decades, that they now find markets coming to them. The purchasing agent of a hotel chain, explaining why he intends to install several thousand laminated window sills, told us that the decision was based on the results of premeditated assaults like those just described. The production engineer of a taxicab manufacturing company, planning to use high pressure laminates for the bottoms of rear seats, displayed a similar attitude.

In industrial applications the story is just the same. The high pressure laminates are invariably chosen where great strength in relation to weight, resistance to inertia, good dielectric and anti-friction qualities and chemical resistance are required and where no coddling by maintenance men is desired. *Resistance to inertia* is a factor of increasing importance and illustrates a rather new engineering slant on the use of laminates. It amounts to this: inertia is dead weight resistance to motion. When a machine traveling at high speeds must be stopped and started frequently and rapidly, the less inertia which the moving parts have the better.

As with the decorative laminates, the markets are coming to these materials. This statement may sound a little strange when considered in relation to the statistical background of the industry. But not when you know the facts.

The production curve

The curve of production statistics of the high pressure laminating industry during the past decade looks like a profile of Mt. Everest. The chart appearing on page 91, built from reports of the National Electrical Manufacturers' Association, shows the course of progress from about 13 million dollars worth in 1937, to over 70 million dollars worth in 1943 and down to 52 million dollars worth in 1945. Figures for the first four months of 1946 stand at $10^1/_2$ million dollars, but this doesn't by any means indicate that production this year will not be way above $10^1/_2$ million multiplied by 3.

The industry made capital investment in impregnating and laminating equipment up to 1941, when the 33 million dollar level of production was hit. It then proceeded to build its huge wartime increase in output by operating 24 hours a day instead of 8, not by adding to capital equipment. Besides this, the laminators were working with more expensive materials during the war so the dollar increase actually represented a smaller physical increase.

So where does the high pressure laminator go from

Work surfaces on kitchen sink and cabinet tops are formed "shells" made of laminated plastic materials

PHOTO, COURTESY CALPLASTI CORP. AND FORMICA INSULATION CO.





COLOR PLATE, COURTESY FORMICA INSULATION CO.

2—The backbar, counter top, kick plates and table tops in this colorful and modern bar installation are of decorative laminate which is easily cleaned and is resistant to alcohol stains and to cigarette burns

here? Is his volume liable to level off at somewhere between the 1941 and the 1943 figures? Is the competition from other materials—metals, wood, contact and low pressure laminates going to be a serious deterrent to future sales? Is the cost of high pressure laminates generally too high for broader peacetime uses? What is going to happen to the balance in materials used—paper versus fabric and both versus glass, and glass fabric versus glass mat? What is the relationship between the future markets for the laminates in structural uses and the availabilty and cost of plywood and low-density core materials?

Huge coating and impregnating machines, drying equipment and space necessities, and large numbers of multi-platen laminating presses constitute a big capital outlay. It costs a lot of money to get into the business and a lot more is required for working capital. So new high pressure laminators do not often appear. It is worthy of note that the capital equipment in the field is uniformly fairly new and in good condition today. Some expansion of production facilities by established laminators is now under way and a few new plants are being built. The standards of quality are high and established. The technology and engineering are sound.

Relation to resin varnish to laminate

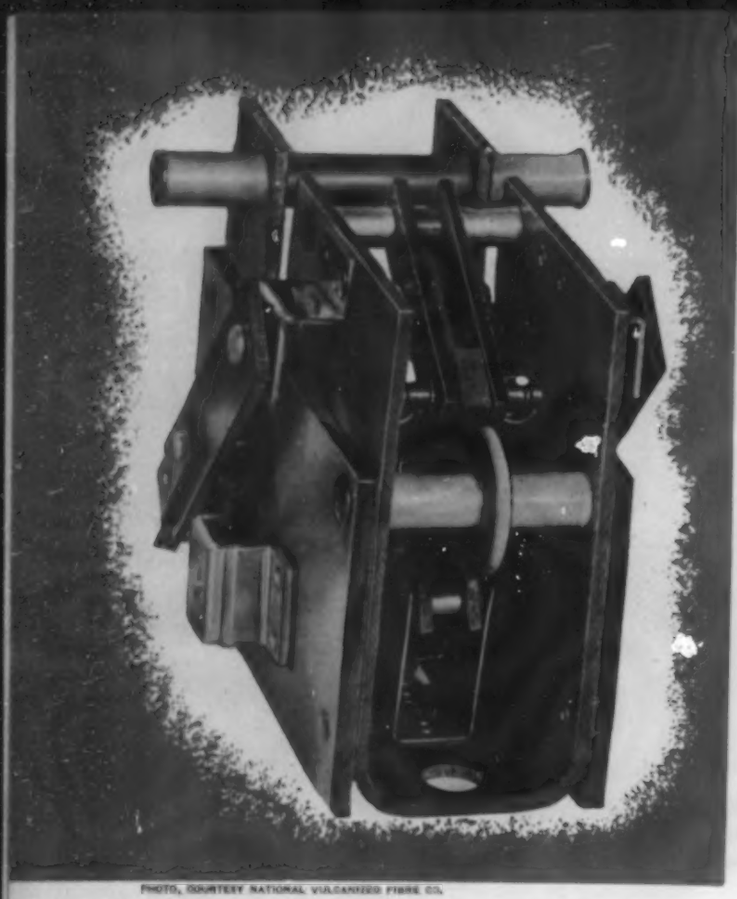
Roughly speaking, a dollar's worth of laminate in sheet, rod or tube form before the war represented a pound of phenolic resin, used chiefly with paper. In those days the industry used paper as filler in more than 70 percent of its products; fabric in 30 percent. During the war, because of military specifications and the availability of fabric, the balance of filler swung to nearly 70 percent fabric and 30 percent paper, with considerable use being made of glass fabric and glass mat for special purposes. Further, there was use of the more expensive resins. The direct relationship between a dollar's worth of laminate and a pound of resin therefore no longer holds.

Also, roughly speaking, a pound of phenolic varnish makes a pound of finished laminate $^1/_{16}$ in. thick. This apparent paradox stems from the facts that a) phenolic varnish contains only about 57 percent resins on a solid basis, b) there are volatile losses in processing and liquid losses in pumping and handling and c) waste in trimming cannot be avoided. The melamine resin for decorative surfaces is supplied in dry form, but represents only a small percentage of the total resin poundage used by the industry. For statistical purposes, if the reader will permit, we will use the phenolic varnish figure as a basic index and will accept the calculation that a square foot of $^1/_{16}$ in. laminate weighs one-half pound. So, when we assess a market in terms of square feet, all we have to do is divide by two in order to figure the poundage and the varnish weight.

Hotel, restaurant and automobile markets

It is impossible to secure a prewar breakdown of this industry's output by markets. But it isn't too difficult to analyze new and widening markets today. The laminates have not yielded to any other materials one iota of their prewar market and, as indicated above, the new markets are coming more than half way to meet them!

The American Hotel Association estimates that $1^1/_2$ billion dollars will be required to rehabilitate, modern-



PHOTO, COURTESY NATIONAL VULCANIZED FIBRE CO.

Circuit breaker chassis of fabric-based post-formed laminates eliminates necessity of insulating component parts



PHOTO, COURTESY PANELYTE DIV., ST. REGIS PAPER CORP. AND MOTOR PRODUCTS CORP.

Four separate laminations compose a home freezer lid assembly. Two make up the lip of the unit and two the cap

ize and build additions to existing hotel structures. Almost 13,000 hotels with over 2 million rooms will find wide structural use for decorative laminates. On furniture tops and window sills the average hotel room would use about 24 sq. ft. of decorative laminate, and if only 10 percent of the existing 2 million hotel rooms are so equipped, an immediate market of 4,800,000 sq. ft. of laminate will be found. The success enjoyed by this type of installation in the new Statler Hotel in Washington has received the close attention of hotel men.

In addition, hotels in the U. S. are immediately in need of half a million dollar's worth of serving trays, many of which can be high pressure laminates, 116 million dollars worth of cocktail lounges and bar equipment, a million dollar's worth of kitchen work tables and 46 million dollars worth of elevators, in all of which the decorative laminates will share to a considerable extent. All of this ignores new hotel construction.

There are more than 170,000 restaurants in this country and at least one-quarter of these will constitute a worthwhile market for the high pressure laminates in table and counter tops. Besides this there are 130,000 drinking places and 39,000 drug stores with fountains, according to the U. S. Census of Industry figures for 1940. Accepting a low estimate of 100 sq. ft. for the average table and counter top area required by these establishments, we arrive at 20,900,000 square feet. The laminates will get close to 50 percent of this business, adding $10^1/_2$ million sq. ft. to their market.

Uses which were developing prewar and which are currently being revived are inner door panels, back-of-front seat panels and bottoms of folding seats in taxicabs. It is estimated that when materials become available, 100,000 taxicabs will be so equipped. At 34 sq. ft. per cab, we can add 3,400,000 sq. ft. of laminate to the more obvious markets.

The market in homes

Every home in the country can use a dinette table with an average area of 12 sq. feet. A market exists for a million of these table tops a month. So again, if only 10 percent goes to the high pressure laminates, we can add an annual square footage of 14,400,000.

The National Housing Administration proposes to erect 2 million new homes during the next year, each of which will have a kitchen; and kitchen equipment people are looking forward to a re-equipment market embracing at least a quarter of the 36 million homes in the country. This gives us 11 million homes to consider. Small wonder that three of the largest companies in the decorative lamination field are preparing to produce kitchen sink work tops at 10 sq. ft. minimum, 10 percent of this market giving us 11 million sq. ft. of laminate.

We have left out the market for high pressure laminates in wall decorations, in home bedroom furniture, in bathrooms, and (with the exception of the kitchen work surfaces) formed articles. Without being generous we can add 10 million sq. ft. for these purposes.

Make-up of the laminates

Most of these laminates will continue to be made from the well proven $^1/_{16}$ in. sheet made of 11 layers of paper, the 9 layers in the core being impregnated with phenolic resin and the outside two, where the decoration is, being melamine. Urea is still widely used in the translucent laminates.

The balance between the fillers is expected to swing back closer to the prewar levels of 70 percent paper and 30 percent fabric. Some of the new papers—such as the oriented crepes—show remarkable forming abilities (we have seen sink tops with 2-way curves made with

this paper) and certain laminators are successfully forming melamine-surfaced materials, both paper and fabric, on a pilot plant basis without crazing. This material is still experimental. In general, the center nine sheets of laminate use about 40 percent phenolic resin to 60 percent paper, while the two outside sheets use about 50 percent melamine to 50 percent paper.

What about railroad cars and airplane structural parts? What about base boards and molding trim for use with radiant heating? What about the field of translucent laminates for lighting fixtures? Again, market statistics are not available and the future is anybody's guess but it should be good.

Core materials

Obviously, all markets for decorative laminates will depend to some extent on the availability and cost of core materials. Plywood has long been the standard and is, to date, the most economical. But plywood isn't readily available at the present time and is not likely to be for some time. Honeycomb is on the way, but at the present time fabric honeycomb is rather expensive at a dollar a square foot, $^3/_4$ in. thick with the high pressure decorative laminates for use as surfacing averaging about 44 cents a square foot in quantity orders. From a standpoint of application, the honeycomb (used as core support for such things as table and sink tops) requires heavy outlay of labor for it must be framed, MODERN PLASTICS is informed.

One company with a new paper honeycomb under development expects to slash present prices by more than half. The paper costs 7 cents a pound against about a 65 cent fabric cost. At least one laminator proposes to ply a laminate to $^1/_{32}$ in. tempered pressed wood at about 60 cents a square foot for the total job. In Canada a large paper mill is going ahead with a lignin board program to provide core material for table tops where plywood cannot be had. A $^7/_8$ in. lignin board sells for 35–40 cents a pound against plywood at 30 cents, but a melamine surface is sometimes applied directly to the lignin. Another company is experimenting with a $^3/_{16}$ in., self-supporting decorative laminate.

The differences in dimensional stability and resistance to warp in core materials has a definite effect on the cost of the completed supported laminates. Just as any laminate must be balanced in itself (e.g., 9 inside sheets plus 1 top and 1 bottom), so the assembly to core, being a laminate, must generally be balanced with the use of the same weight of sheet on the bottom as on the top, although only the top is decorated.

Laminates and competing materials

In the decorative field, the high pressure laminates compete with different materials in each type of application. In table tops they compete with enameled steel, which chips, stains and warps under too much heat; with glass, which chips and shatters and is cold to the touch; with wood, which dents and stains and costs a lot to maintain. In kitchen work surfaces they compete with linoleum, which has to be strongly sup-



PHOTO, COURTESY FARLEY & LOETSCHER MFG. CO.

Hand luggage, while not a big outlet for high pressure laminates, shows the various possibilities for forming

Decorative laminates, because they are moisture resistant and easily cleaned, can be used effectively for bathroom walls. However, until material and installment costs are lowered, their use may be restricted somewhat

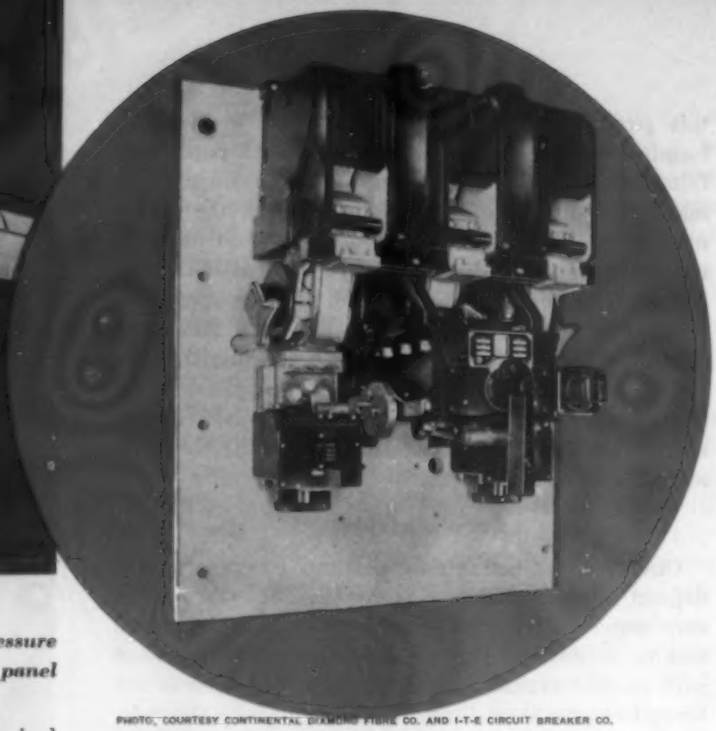
PHOTO, COURTESY MICARTA DIV., UNITED STATES PLYWOOD CORP.





PHOTO, COURTESY GENERAL ELECTRIC CO.

Fluorescent lighting fixtures also use high pressure laminates, this time in the form of a translucent panel



PHOTO, COURTESY CONTINENTAL DIAMOND FIBRE CO. AND I-T-E CIRCUIT BREAKER CO.

A circuit breaker with 50 percent of its weight in laminated materials, reflects the increasing demand for a variety of electrical grades of industrial laminates

ported, which pits and which has not the same chemical resistance; with tile which will not stand up to vibration and impact; with stainless steel which, while expensive, is always a problem to keep looking attractive and which stains under some circumstances; with enameled metal, which cannot take nearly the same punishment.

Surprisingly, final costs of all table and kitchen work surface top materials—given equal chemical and physical qualities—are about the same. Linoleum has a slight advantage, but even wood, so treated as to make it resistant to acids, alkalis, heat, etc., becomes expensive. In general, flat surfaces, without edging, cost about $1.25 a sq. ft., with plywood or other core support material figured in.

Edgings are a point of difficulty in all cost calculation, because a 4 by 4 ft. table will have a 16 ft. edge, while an 8 by 2 ft. table, with the same surface will have a 20 ft. edge. In the post-formed sink tops, some are straight "L" form with metal or extruded plastic edging applied to the top edge of back surface and to the front edge of the horizontal surface. Others have a back top edge and a front lip molded in, but these are said to be further from the market being only now in the development stage. Some may have laminated edgings, but when cost competition rears its ugly head, these may not be too big a factor in the field.

In bars and restaurants and in the hotel furniture field, competition from other materials isn't expected to be serious. After all, maintenance and ease of cleaning is the big factor here, with beautiful colors and pleasant touch the second consideration.

As to the structural uses, while they will depend on the core materials, they will also depend on the development of adhesives and bonding methods. The new electronic spot welder shows possibilities with some of the room-temperature setting resin adhesives in allowing a sheet of thin laminate to be applied to a flat, vertical surface and spot welded thereto, the adhesive being allowed to take its time in setting, permanently bonding the laminate to the wall.

But competition on this wall application is going to be heavy. The contact pressure laminates, the vinyl wall covering materials, metal and wood and fabric and linoleum will all be in the running. A thin sheet of aluminum bonded to a thin ply of textured wood, is currently being applied to wall surfaces—the metal being on the inside. This construction has advantages in cities where the structural use of wood, unless fire-proofed, is limited to buildings less than 150 feet high. It costs about 35 cents a square foot which is quite a lot cheaper than even regular $^1/_{16}$ in. decorative laminate. Another newcomer is striated plywood, a 3-ply sheet $^5/_{16}$ in. thick, bonded for internal grade with urea to sell at 13 cents a square foot and for exterior grade with phenolic to sell at 20 cents a square foot. It is applied with urea glue and, to date, has proved up very well.

The new papers, being developed for surfacing plywood right on the press, mean further competition for the laminates. Some of these resin-impregnated papers can be applied to ply for as little as 3 cents a square foot in such a way that a rather poor piece of wood cannot only be made resistant to cigarette burns, alcohol stains, acids and alkalis, as well as moisture, but can be made beautiful.

On the whole, it is unlikely that the high pressure laminates will receive wide use in the wall decoration field.

Adding up the decorative applications, we find a minimum market for almost 50 million sq. ft. of high pressure laminate. Decorative laminates normally account for not more than 15 percent of the total output

of the industry. So the total market for high pressure laminates can amount to about three times the wartime high volume, *if* the market for industrial laminates is proportionate. Let's look at that market.

Industrial applications

The industrial uses of laminates are apparently going to follow the historic pattern of the industry with notable expansions and additions. The electrical field and the related communications field will continue to use them in large quantities as insulation, panel material, casing material, etc.

No one offers even a rough guess at the expansion due in this market, but the Committee for Economic Development estimates, reported in our January issue, have communication equipment for 1947 figured at 44.1 percent higher than in 1939, electrical measuring instruments at 34.7 percent higher and wiring devices and supplies at 45.8 percent higher. Which means, even if there were no increased use of laminates by these industries, that there would still be an increase of 40 percent in the market.

The electrical field has always used both paper and fabric filled phenolic laminates, but the war brought out the Navy's glass fabric bonded with melamine resin which has high strength, high arc resistance when wet or dry, and heat resistance. Today this product is standard with the Navy and is being specified by the electrical industry where the cost (about $3.20 per lb.) can be justified. However, we still have to hear from the silicone-glass laminates, now undergoing tough tests.

Just how far the silicone-glass laminates will go at the present very high prices is hard to say. Those who claim that Uncle Sam is no longer paying the bills may be forgetting that several power authorities are in prospect to carry the T.V.A. program into other areas—and Uncle Sam, who wants only the best, will be footing the bills for them!

In addition, several laminators are in the market with new products, generally, asbestos-melamine laminates, designed to give remarkably good combined arc and heat resistance in the presence of moisture at much lower prices.

There is no point in discussing laminated gears here. Everyone who is interested knows the superiority of these gears, proved through long years of constant use, and know the standards now set for them.

The textile manufacturing industry has for a decade been a big user of high pressure laminates. Picker sticks, bobbins, doctor blades, carrier rolls, loom box linings—18 uses in this field are listed—are the standard lines. But within the past few months much research has led to new uses in textile machinery.

In all textile processes static is generated by friction. The high pressure laminates overcome this problem and those created by grease, solvents, abrasion and inertia. The C.E.D. report forecasts an increase of 132.9 percent in rayon and allied products in 1947 over 1939. Nylon production is also increasing rapidly. Competition between the fibers will necessitate faster equipment—and the use of more laminates.

Related to the uses of laminates in the textile fields are those in the chemical and plating industries. Plating barrels, valves, bushings, sleeves, plugs, linings for various pieces of equipment have now a firm market.

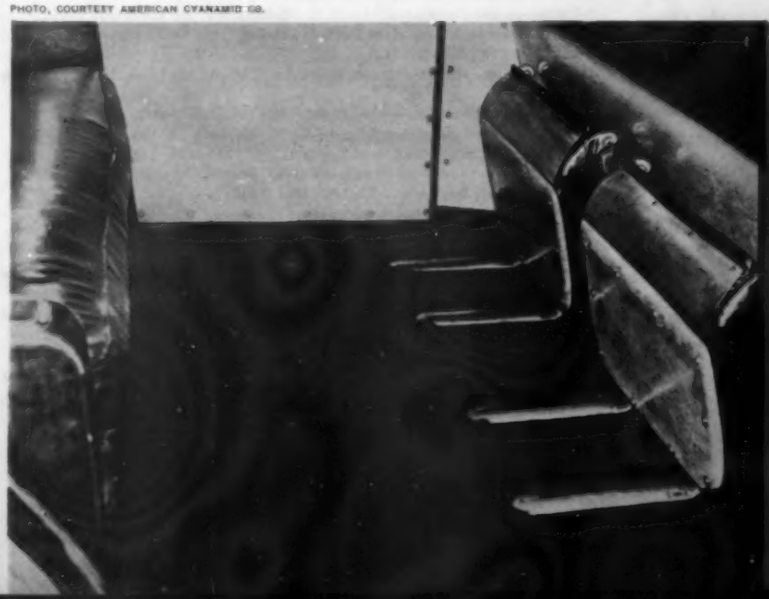
From the aircraft industry during the war, the machinery industry[1] learned much about overcoming inertia through the use of plastic laminates. With half the weight of aluminum and one fifth that of steel, these parts represented also a lower outlay for jigs, fixtures and forming tools. The strength-weight ratio is the important factor, because modern machinery must travel at very high speeds, yet must be able to start and stop frequently and easily. Pulleys, axles, ball bearing retainers, bearings, cams, pinions and other items are gradually being standardized in laminate materials.

The automotive field embraces uses common to the electrical, chemical and mechanical field. The pieces

[1] "Molded-laminated phenolic propeller parts for aircraft," MODERN PLASTICS 21, 109–113, 170 (Jan. 1944).

Left—A paper-based melamine-surfaced laminate is used for inside paneling and kick-plate of folding jumper seats in taxis. Right—Taking advantage of its anti-friction, anti-inertia, resistance to moisture and chemical qualities, this V-belt pulley for a textile machine is formed with a macerated fabric filler

PHOTO, COURTESY AMERICAN CYANAMID CO.



PHOTO, COURTESY SYNTHANE CORP.



used in this industry are small, but the volume is large.

The marine bearing housings for stern tube shafts developed in 1943[2] from a cotton fabric laminate are now standard in ship construction and repair. From this beginning, other bearings for underwater use, as in steel rolling mills, have become general practice. Not a large market, but an important one from the standpoint of future applications.

Panels, breaker strips and other parts for a refrigerator used 5.07 lb. of high pressure laminates before the war. These are molded-laminated, using paper or fabric fillers and phenolic resin. In 1941 we manufactured 3,700,000 domestic refrigerators and in 1947 should produce 5,520,000[3], making a market (at 50 percent) for 14,000,000 lb. of laminates. An extension of this business is in housings for air movers, panels for diesel engines and for juke boxes.

What other uses?

What else? A thousand and one applications, all based on these main uses. Urea and phenolic paper laminate is being successfully used as printing plate material. An oil well bomb is based on a wartime product made for the Army Ordnance Dept. In smokestacks in New Jersey, tests are being conducted on an electrostatic chimney-cleaner which uses many sheets of laminate. Washers, grommets, bushings, small parts by the millions are produced every day.

While the laminators generally did not expand press and impregnating facilities during the war, they more than doubled their own fabricating departments.

Laminators interviewed all advised that their postforming business has dropped to less than 15 percent of what it was at the wartime peak. Where quantities do not justify the expensive tools used for forming during lamination, where labor costs can stand to be higher per piece, where design changes are likely to be fairly frequent, postforming should find a big place.

An interesting sidelight on postforming is the ammunition box which was made by the millions in 1942 and '43, and which now promises to be recreated in luggage pieces, salesmen's kits, filing drawers, bread boxes and such things. Shipping costs will be an important factor here, although aluminum, contact laminates and fiber will be competitors. The fabric people are working closely with postforming houses.

Finally, what have we got that's new and that is likely to affect the picture? Rated fabrics, for one thing, with strengths known and no gamble in their use. Papers such as Patapreg, developed by the Forest Products Laboratories, which are formable in compound curves. Knit fabrics for the same purpose. Laminates with nylon fabric filler and melamine or phenolic resins for communication and radar work. Glass mat and glass fabric for specific uses where high strength, heat resistance and dimensional stability are required, and where use justifies the price. A dozen new laminating resins with special advantages. Combinations of glass fabric, paper, fiber, rubber, wood and other materials in single sheets, rods or tubes of laminates, either to improve the qualities of the product or to bring down the costs, or both. Engraving stock, white inside, black outside, for use in instrument faces, dials, instruction signs, etc. Wood-surfacing papers mentioned earlier. Firm standards of quality and fabrication practices.

What haven't we got? Enough paper, enough fabric, enough resin, enough core materials. You name it. The laminating industry hasn't enough of it. Enough, that is, to meet the markets that are coming to it!

[2] "Resin-bonded marine bearings," MODERN PLASTICS 21, 78–79 (Nov. 1943).
[3] "What's ahead for 1946," MODERN PLASTICS 23, 96 (Jan. 1946).

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Bibliography

Readers can find in MODERN PLASTICS General Index of Titles a list of all articles on high pressure laminations running up to August 1945. The following have been featured since that time:

"Postforming and its application," 23, 129 (Sept. 1945).

"Variation of tensile strength and elongation of plastics with temperature," by R. T. Schwartz, 23, 153 (Sept. 1945).

"Bagasse resin laminates," by T. R. McElhinney, 23, 121 (Nov. 1945).

"Weave as it affects glass cloth laminates," by F. J. Meyer and Erven White, 23, 137 (Nov. 1945).

"Fabrication of high-pressure laminates," by R. M. Lane, Part I, 23, 146 (Dec. 1945).

"The pyrolizer and its development," 23, 127 (Jan. 1946).

"Resin bonded glass fiber fly-rod," by M. Howard, 23, 124 (Feb. 1946).

"S.P.E. annual convention and exhibit," 23, 135 (Feb. 1946).

"Fabrication of high-pressure laminates," Part II, 23, 148 (Feb. 1946).

"Deep drawn laminates," 23, 100 (Mar. 1946).

"New plastics parts boost refrigerator efficiency," 23, 104 (Mar. 1946).

"Postforming methods and applications," by W. I. Beach, 23, 142 (Mar. 1946).

"Manufacture of compreg in Germany," by R. Richardson and G. M. Kline 23, 155 (Mar. 1946).

"Silicone resin bonded laminates," by L. V. Larsen, J. J. Whelton and J. J. Pyle, 23, 160 (Mar. 1946).

"S.P.I. conference and plastic exhibit," 23, 109 (May 1946).

"A comparison of laminated materials," by J. C. Pitzer, 23, 126 (May 1946).

"Renovating rail cars with plastics," 23, 100 (June 1946).



New sturdy companions to brighten any kitchen are the ice crusher with urea base and the orange juicer of polystyrene and cellulose acetate butyrate

Durability counts in kitchen equipment

JOINING the parade of plastic household items are a streamlined ice crusher and a neat two-color fruit juicer. Both are sold by Dazey Corporation.

Fine, medium or coarse crushed ice according to the whim can be produced in the 2-piece ice crusher. The body of the unit, where the ice is cut by revolving blades, is metal. But the ice cup and knob are molded of red, green, yellow or black Plaskon.

A thermosetting material was picked for this application because the cup must hold its shape to be serviceable; urea was adopted for its color-fast and odor-free qualities. The piece is molded in a 4-cavity semi-automatic hydraulic press of 200 ton capacity on a 5-min. cycle. The material is first heated in an infrared oven to remove the gasses, then placed in the mold for final cure. Upon removal from the press, cups are placed on cooling fixtures, inspected and finned, polished, buffed.

One interesting feature of this piece, which is produced by Imperial Molded Products Corp., relates to the mold. Because the locking lugs that hold the cup in position under the metal body of the crusher involved an undercut, it was necessary to make the force or punch so it telescoped, sliding down so that the piece could be removed without breaking the lug.

As for the juicer it was made originally of aluminum. However the company felt that plastic would offer a number of advantages—for example, resistance to discoloration and corrosion. After a series of tests, the Injection Molding Co. settled upon Tenite II for the strainer and bowl and upon Tenite II, Bakelite polystyrene, Lustron or Styron for the reamer.

The reamer is produced in a 2-cavity mold at the rate of 100 shots per hour on a 36 sec. cycle. A 2-cavity mold is used for the bowl with 50 shots per hour on a 72 sec. cycle. The only finishing required is removal of gate.

The strainer is turned out in a single-cavity mold at a rate of 120 shots per hour on a 30 sec. cycle. In addition to the removal of the sprue the parting-line edge must be trimmed. Strainer and reamer come in yellow, green, red, black and white; the bowl in white only.

An experiment in restaurant tableware

by PRESCOTT FULLER*

MELAMINE-formaldehyde plastic tableware, scientifically designed to meet the requirements of restaurant service, was displayed for the first time by the American Cyanamid Company at the National Plastics Exposition in May of this year. As the supply of dishes to this market involves a tremendous volume, there has been an enthusiastic response on the part of molders and potential users to the debut of this new product which would seem to call for a report on the testing program undertaken on these dishes.

The project was initiated to determine whether or not melamine plastics are suitable for restaurant use. This field, which requires that tableware withstand continuous rough handling, offers the severest possible test. If the new tableware gives satisfactory performance, its suitability for institutions, college dining rooms, railroads, industrial cafeterias, commercial aircraft and for everyday use in the home is assured. It is not the intention of our company to market the finished parts. Rather, the experimentation is intended to be an evaluation of the material in the interest of better plastic tableware and the results will be passed on to molders.

Thermosetting plastics have been molded into tableware for many years and the volume of colored material used for this application has always been large. Until now, tableware has largely followed the line of home use. These applications have proved satisfactory and have been widely accepted by the public. And there has been some volume used on yachts and aircraft.

In 1939 the first melamine-formaldehyde molding material was introduced in the form of an alpha-cellulose filled compound. In molded parts it possesses very low water absorption, has excellent surface hardness, is available in an unlimited color range and is resistant to boiling water. In addition, it was found to be odorless, tasteless and resistant to staining and chemical attack. Immediately, the potentialities of this new plastic for restaurant tableware were considered.

Before any extensive development work could be accomplished, the United States entered the war. The Navy, searching for tableware which would give satisfactory performance under the severe service conditions aboard ship, where rough seas and the impact of gun fire would shatter ceramics, began to order melamine tableware. The fact that dishes made from this material could be conveniently nested was of extreme importance. Existing dies for household tableware were improved by American molders, wherever possible, in an effort to provide thicker, more substantial and durable products. Navy reports on this tableware indicated its suitability for heavy duty and there were repeated reorders.

* Plastics Div., American Cyanamid Co.

The program and the goal

Encouraged by wartime performance, our company made the decision to investigate thoroughly the tableware possibilities of melamine-formaldehyde plastics. The program decided upon involved these points:

1. Sales price would be disregarded.
2. The best technical men in the development laboratories would be assigned to the project.
3. A well-known designer of tableware would be retained.
4. Restaurants, chosen not for ease of handling but for severity of service conditions, would be asked to cooperate. They would be consulted on properties desired and on the conditions of actual service tests.

It was decided to start from scratch. The first step was to contact restaurant chains such as Pennsylvania Drug Co. and Bickford's. These concerns were asked, "What properties do you require of an ideal tableware for restaurant use?" The consensus was that:

1. There should be little or no breakage.
2. Tableware should be light enough to permit a large number of servings at one time.
3. Bus boys should be able to carry a large load of dirty dishes without suffering from undue weight.
4. Food should be served the patron on attractive plates.
5. The tableware should have insulating properties which would keep food hot or cold as desired.
6. Plates should be pleasant to the touch.
7. Product should be odorless and tasteless, resistant to staining and attack by foods.
8. Chipping, fading and discoloration should be eliminated.

Proper design was considered of utmost importance. Russel Wright, industrial designer, was called in as a consultant to coordinate design program.

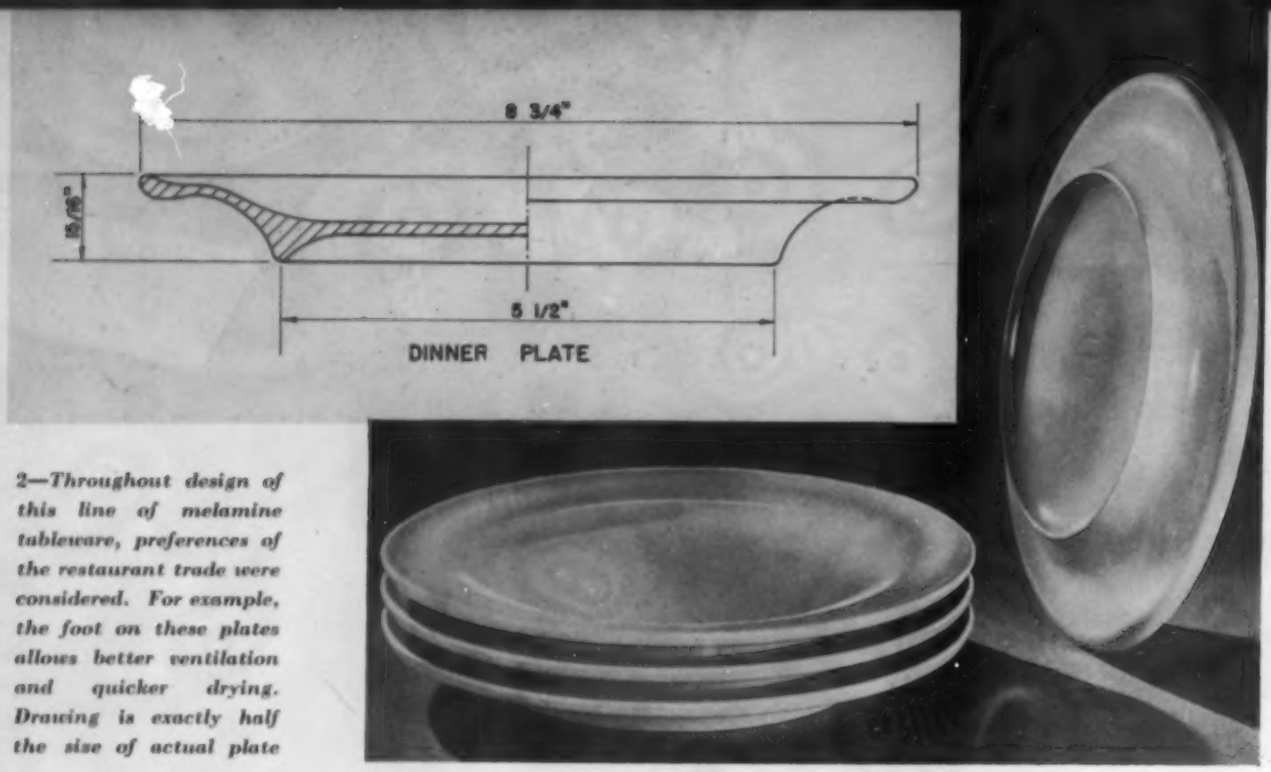
The restaurants did not want a flimsy, fragile product—they were interested instead in the properties of light weight combined with strength. The sizes and capacities of the various cups and dishes along with their appearance were also important. The principal role of our company in the design of the tableware was to make sure that the designs were consistent with good molding (that thickness provide serviceability).

As development work proceeded, several important factors materialized. The cups were designed with a nesting feature shown in Fig. 3. Plates have a *foot* on the bottom, the primary purpose being to raise the lip of the plate high enough off the table to enable it to be picked up with ease. This foot also allows for better ventilation and quicker drying, and eliminates the tendency of the dishes to stick together. Another feature is the undercut lip in the form of a reentrant curve



COLOR PLATE AND PHOTOS, COURTESY AMERICAN CYANAMID CO.

1—*Dinnerware compression molded from melamine sets a nice table—one that is both colorful and insured against the perils of slippery hands and clumsy elbows. Seven different sizes and shapes of plates, cups and bowls are now being subjected to a rigorous test in some of New York City's busiest and most popular eating places—ranging from quick-lunch counters to full-fledged restaurants*



2—Throughout design of this line of melamine tableware, preferences of the restaurant trade were considered. For example, the foot on these plates allows better ventilation and quicker drying. Drawing is exactly half the size of actual plate

which makes the dishes easy to grasp without dropping.

Mr. Wright, after consultations with the American Cyanamid Co. and the restaurants, decided on seven different plates, cups and saucers of a size and shape consistent with restaurant tableware experience.

Molds, materials and molding technique

The most important factor in mold design was to obtain a high degree of polish. All molds were chromium plated, of a semi-positive type and landed. Flash lines were placed so that the definning job could be done with ease and be as inconspicuous as possible. Often they were placed where there was a break in contour of part.

Capital was made of the fact that a plastic handle can be molded as an integral part of the cup rather than attached later, as with china. The cup handle is molded with a through pin in order to eliminate the use of an insert. This obviates the flash line which would have been present where the insert was placed.

All molds have been carefully cured so that uniform heating can be obtained and adequately controlled The design of the molds allows sufficient loading space so that high bulk materials can be used if desired.

As previously mentioned, the purpose of the project was to determine the suitability of melamine-formaldehyde plastics for restaurant tableware. Standard alpha-cellulose filled formulations have been used, and impact materials have also been molded into this new line of tableware. No special compounds were necessary.

The first step in the actual production was to very carefully determine the cure required on each of the seven parts. Cure and temperature cycles were set so as to closely adhere to the optimum required for best water resistance and surface appearance (Table I). A careful study of the best molding cycling and a prewarming analysis were also made. Very tight inspection standards were maintained in order to eliminate all defective parts, including those which had been contaminated.

As for the method of preheating, the final decision was to use high frequency since it seemed to give the best surface and over-all appearance while keeping contamination at a minimum. It also reduces cure time. Since, in most cases, more than one of the 3-in. in diameter preforms must be used, they are loaded one on top of the other. Careful weighing of the preforms insure the correct molding charge.

Close checks on the degree of cure were maintained as measured by water resistance, and by a special boil test conducted in a 1 percent sulfuric acid solution.

Program of testing

It is now the intention of our company to gather as extensive data as possible on the performance of this tableware under actual service conditions. Complete information on hardness, breakage, cleanliness, and consumer and restaurant personnel reaction, will be obtained from the participating restaurants. In all cases an attempt is made to keep the plastic tableware separate from dishes made of other materials, both in handling and in washing.

Table I.—Optimum Cure Cycles for Melamine Tableware[a]

Part	*Cure*	*Finished piece weight[b]*
	min.	*grams*
Saucer, 6 in.	3	115
Cup, 7 oz.	3 1/4	110
Fruit saucer, 5 in.	2 1/2	85
Cereal bowl, 1 1/2 in. deep by 6 in.	2 3/4	142
Soup bowl, 2 in. deep by 6 in.	3	161
Salad plate, 7 1/2 in.	3	203
Dinner plate, 8 3/4 in.	3 1/2	265

a All parts molded at 320° F.
b Accuracy of weight, 2 grams. In old charge 6 to 10 percent in excess of weight of finished piece.



3—Design of cups is such that they may be compactly nested together. A feature is that the handle is molded integrally instead of being attached later as with china cups. Again, drawing is half size

The first restaurant chain to be so equipped was Nedick's which entered into the project some time ago. Inasmuch as yellow is the predominant store color, 1200 salad and dinner plates of this color were placed on test in their restaurant at 42nd St. and Lexington, and over 500 at their place at 40th St. and Sixth in New York.

The Pennsylvania Drug Company's restaurants at the Pennsylvania Hotel and at their store in Forest Hills, L. I., have been equipped with the entire line of seven different pieces (about 20 dozen sets) made in powder blue to fit the company's color pattern.

Soon Bickford's will be supplied with about 50 dozen sets, molded in white. Present plans are to supply one store in a hard water area and one in a soft water area to get comparative data on washing and general durability. An installation at the Arcadia Restaurant, 45th and Vanderbilt Ave., will round out the program.

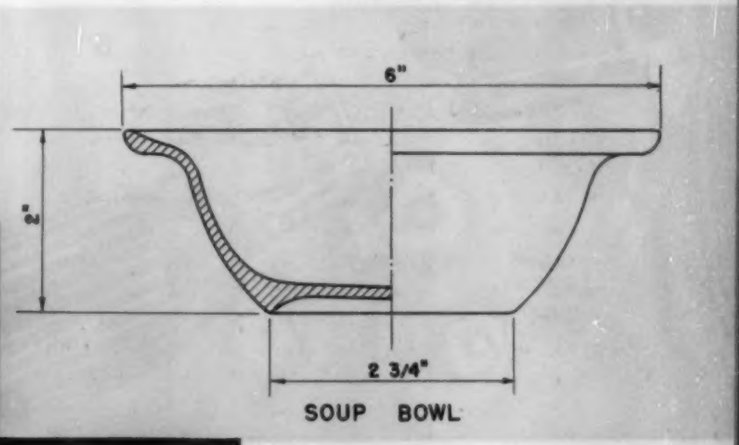
To acquire data on all types of service, these field evaluations are being conducted in diversified types of restaurants. Nedick's specializes in counter service of the quick-lunch type. The Pennsylvania Drug Company, while still providing counter service, supplies more complete meals. Bickford's will give data on the severest type of counter service (dog wagon) while the Arcadia Restaurant caters exclusively to a table clientele. As production permits, and if the information is required, other restaurants will be added.

To ascertain how well the new melamine tableware cleans in the dish-washing equipment, a series of 60 white plates were sent to a sanitation unit of a midwestern university for test purposes. These dishes will be smeared with *standard soil*—materials which usually make plates dirty, such as grease, eggs, acids and juices.

When complete data regarding performance, cleaning and consumer restaurant reaction have been collected, such information will be made public property. In particular, it will be made available to the entire molding fraternity, stressing the value of correct design and indicating the possibilities of this large volume market for the promotion of melamine-formaldehyde tableware.

4—This soup bowl, which is half its actual size in the drawing, has an undercut lip in the form of a reentrant curve. This design which is carried through the entire line, makes the dishes easy to grasp and hold without dropping. There is also a cereal dish of the same diameter as this soup bowl but with a depth of just 1½ inches





3 razors—

1 *Molded-in raised squares on either side of this phenolic razor housing assure a firm grip. Streamlined contour gives the case a modern appearance and makes for easy handling of the shaver*



ELECTRIC razors were among the first reconversion products to hit the market. Having reached a high state of perfection before the war the razors offered early this year were further advanced in design than many other items of consumer goods and, consequently, found a ready market. From that early start, the manufacturers proceeded to redesign, incorporating war-born engineering improvements in the postwar models that are now reaching the market.

The new electric razors make universal use of plastic housings and functional components, and their construction represents a high standard of production and mold design. Because dimensional stability, dielectric qualities, resistance to alkalis and moisture are demanded in these products, the plastic materials are carefully chosen and just as carefully handled. Fur-

2 *Two molded phenolic pieces make up housing of this electric safety razor—the 1-piece handle, which holds the vibrating motor, and the end cap. The razor, presently produced in red, depends upon the parallel grooved lines running up and down the handle for its non-slip qualities*



3 materials

thermore appearance in the merchandising of such small but relatively high-priced pieces of merchandise as electric razors is as comparably important as in the sale of high quality fountain pens. Blemishes in the moldings are not tolerated.

Yet manufacturers have found standard grades of several plastic materials, if carefully kept from contamination, to be quite satisfactory from all these standpoints. Polystyrene, phenolic, urea-formaldehyde and melamine are all being used.

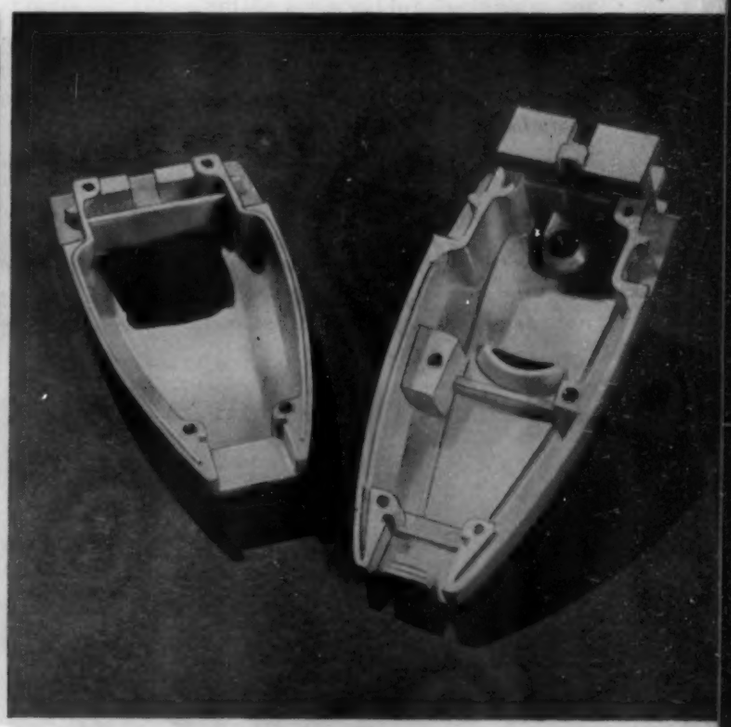
The Remington electric shaver housing, redesigned to accommodate the triple head, has been very acceptably produced by compression molding of Beetle and injection molding of Styron. Though the mold designs represented a challenge, inserts being used in both parts of the housing, the finished job has given satisfaction to both the manufacturer and its customers.

The Racine De Luxe Esquire electric safety razor, a new departure which features a vibrating motor, has a two-piece red Bakelite case. The larger part serves as a housing for the operating mechanism and as a handle, the other portion as an end cap to seal the housing and provide a cord outlet hole. Positive-type 4-cavity molds are used for the molding of this case. Curing time is 4 min. at 285° F. under 28 tons pressure. A thermosetting material was chosen to prevent softening or distortion of the housing, should the vibrating mechanism overheat.

Durez phenolic is used in both the Knapp shaver and in its plug attachment. In this case the special design considerations were surface appearance, balance in the hand and maintenance of close tolerances.

3 *Body of the housing for this electric shaver is compression molded of urea while an end piece is injection molded of clear polystyrene. Difficulties encountered in compression molding the body can be appreciated when examining picture at the right showing all the inserts and varying wall thicknesses required by the design. Like the case shown in Fig. 1, this electric shaver housing is streamlined but a firm grip is assured by its raised and recessed contour which is designed to fit the hand perfectly*





Integrating plastic and rubber industries*

Parts made from various plastics and synthetic rubber exhibit a number of improved properties

by R. P. KENNEY†

THE rubber and plastics fabricating industries of prewar years have in effect lost their separate identities, their end products and raw materials having become interchangeable. The chief catalysts or driving agents in the amalgamation of these two hitherto distinct industries have been the polyvinyl plastics and certain types of synthetic rubbers. For the purposes of this article I will refer only to the acrylonitrile-butadiene type synthetic rubbers.

As the laboratories of the rubber and plastics companies began to experiment with the various polyvinyls and synthetic rubbers they soon discovered that some polyvinyls were compatible with certain types of synthetic rubbers. It became apparent, through the process of elimination, that the combinations showing the most promise were those mixtures of vinyl chloride type polymers and acrylonitrile type synthetic rubbers. Some of the improved properties deriving from the addition of plastic to synthetic rubber are:

1. *Increased flex life*—Tests have shown that some products made from these blends have double the flex life than when made entirely with synthetic rubber.

2. *Sunlight and ozone resistance*—By the incorporation of 25 percent or more vinyl chloride type resin into a synthetic rubber compound there is a remarkable increase in the resistance to sunlight and ozone. This property was of real value to the war effort when the improved synthetic rubber compound was used for the manufacture of fuel cell fittings for the Air Forces.

* Presented at annual meeting of The Chemical Institute of Canada on June 25, 1946, at the Royal York Hotel, Toronto, Canada.

† Manager, International Sales, B. F. Goodrich Chemical Co.

Ice bucket, propeller de-icer ring, shoe sole, gasoline hose and industrial screw driver are composed of combinations of polyvinyl chloride, phenolic and acrylonitrile

PHOTOS, COURTESY B. F. GOODRICH CHEMICAL CO.



3. *Reduced flammability*—It is logical to expect the strictly non-inflammable vinyl resins to impart this quality to the more flammable synthetic rubber.

4. *Reduced creeping in lightly loaded stocks*—The vinyl resins serve as a loading material and help to cut down the nerve of the rubber.

5. *Improved abrasion resistance*—Addition of vinyl plastics markedly increased the abrasion resistance.

Further exhaustive tests proved that synthetic rubber added desirable qualities to vinyl resin just as vinyl added desirable qualities to synthetic rubber.

1. In the first place, as a result of adding synthetic rubber to vinyl resin it was possible to decrease the amount of ester type plasticizers formerly needed. Not only do these plasticizers tend to be volatile but some of them have the very objectionable property of being extractable. The use of synthetic rubber reduced this fugitive tendency and thereby increased the resistance of vinyl compounds to staining and attack on varnished surfaces.

2. The substitution of synthetic rubber for some of the chemical plasticizer in a vinyl compound was found to greatly improve the oil resistance. This is due to the fact that some chemical plasticizers are usually extracted by oil while acrylonitrile synthetic rubbers are virtually unaffected.

3. The adding of synthetic rubber also opened the possibility of higher loading, therefore giving lower cost compounds. This can be attributed to synthetic rubber's higher tolerance for inert filler as compared with that of the vinyls.

4. Other advantages which these synthetic rubbers impart to a vinyl chloride plastic compound are improved elongation, improved compression set and cold flow characteristics, greater resiliency and improved low temperature flex life. Such blends, for example, can be used at temperatures about 25° C. lower than can conventional vinyl plastics.

5. A final and very important property which synthetic rubber gives the vinyl compound is the ability under proper conditions to be pulled from a hot mold without being torn. In other words, it is now economically possible, due to elimination of need for cooling the molds, to compression mold thermoplastic products from polyvinyls. This is not a theoretical consideration; several large rubber fabricators are actually taking advantage of this property in their standard production operations. The nervy uncured synthetic

rubber adds enough strength to the more thermoplastic polyvinyl to permit high temperature handling.

Examples of what material can do

Compounds prepared from a combination of these three materials show a wide range of possibilities ranging from a soft elastomeric compound such as is used in the manufacture of propellor de-icer rings to a hard, tough compound used in a screw driver handle.

In the case of the de-icer ring the phenolic was added to give a slight firmness or rigidity to the compound which could not be obtained otherwise. The polyvinyl chloride contributes to the abrasion resistance as well as the aging characteristics.

The phenolic is used in the screw driver to give a hard compound without the need of excessive quantities of sulfur and accelerators. The phenolic seems to act as a curing agent by replacing sulfur. This substitution not only improves the electrical properties of the compound but gives a superior impact strength. Polyvinyl chloride improves electrical characteristics.

Many fabricators of hard phenolic molded items have discovered that the addition of certain acrylonitrile type synthetic rubbers produce a higher quality product than has been possible heretofore with straight phenolics. An example of such an application is an ice bucket to which a small amount of synthetic rubber has been added to increase the brittleness of the compound, to give extremely high impact properties, to improve water resistance and, therefore, the dimensional stability, and to improve the chemical resistance.

Another example is embossed upholstery material made by a combination of phenolic resin with synthetic rubber, which may have greater possibilities than any of the other items mentioned.

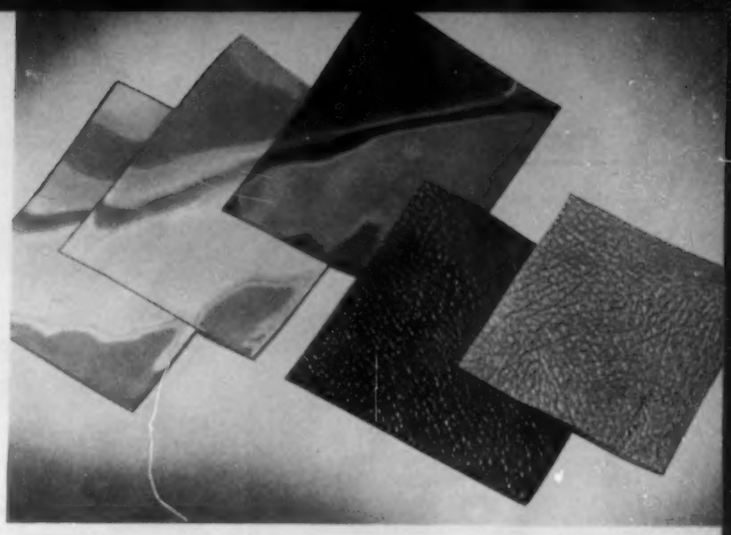
We don't know yet exactly what happens in this combination of synthetic materials although there are many theories. It may be there is a cross-linking reaction between the rubber and the phenolic or possibly the phenolic may enter into condensation in a separate phase from the rubber. In any case, the results are that we get a cured unsupported sheet that has superior properties to a similar plasticized polyvinyl chloride unsupported sheet.

Since this work is quite new, we do not have enough technical data to more than mention them now.

Effect on future of two industries

As the examples that we have described indicate, this interchange of end use will have a profound effect on the future planning of the rubber and plastics industries. Each industry has acquired new and valuable tools (or raw materials) which will greatly expand their field of endeavor, and the rubber compounder and the plastics engineer must have a complete knowledge of these new materials to obtain the best compounds.

This combination of plastics and synthetic rubber has also had the effect of making these two industries more dependent on the same raw materials. Before the war the rubber industry had no more than a secondary

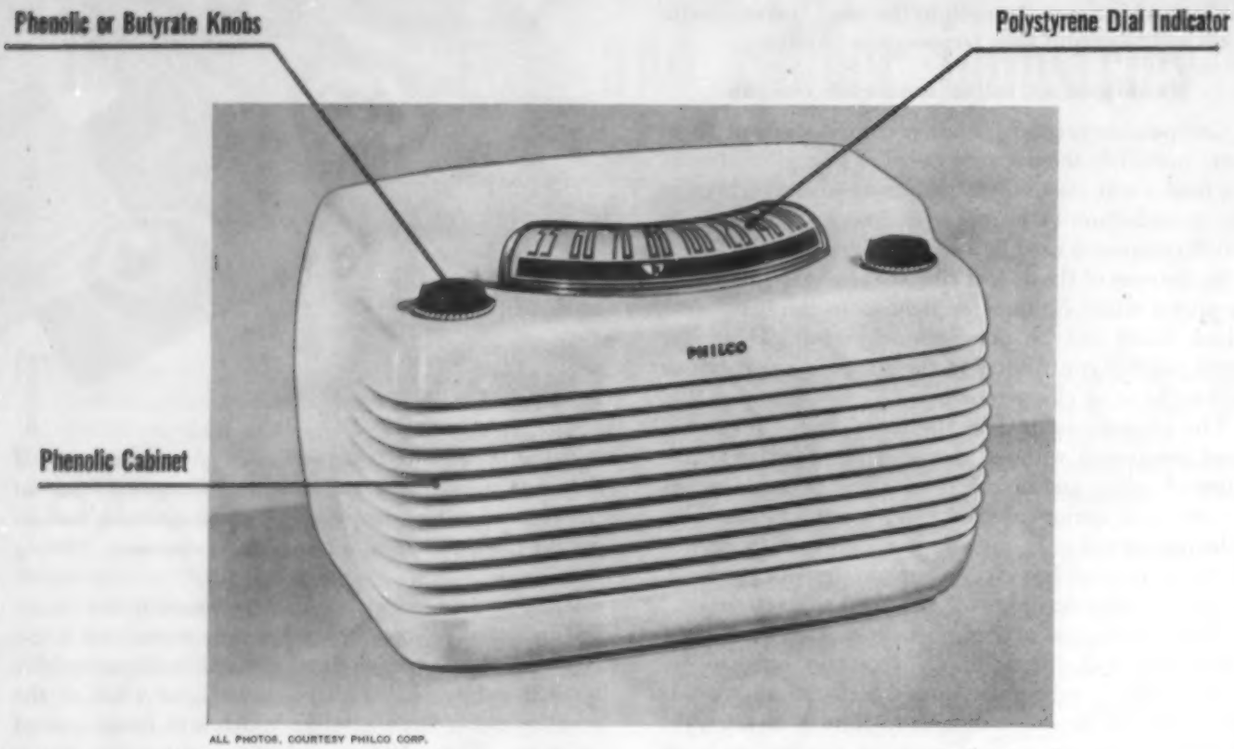


Polished samples (left) are composed of a combination of polyvinyl chloride and acrylonitrile. Embossed material (right) is a combination of phenolic and synthetic rubber. All the pieces are from unsupported calendered sheeting

interest or dependence on what happened in the chemical industry. Now they are vitally concerned if the chemical plants lose production on phthallic anhydride (and therefore phthalate plasticizer), or whether the caustic plants have a strike which will mean loss of chlorine. The plastics industry, although always more dependent on the chemical industry, now has to consider carbon black production, various rubber chemicals and chemical softeners.

Finally, and most important, these new materials will have a profound effect on the economic future of both industries. When the tools (or raw materials) of each become interchangeable, both industries will become subject to the same economic influences. The rubber fabricator whose main concern in the past was the world price of crude rubber now will have to be aware at all times of the prices on a hundred and one different synthetic, rubber, plastic and chemical raw materials. The plastics fabricator will also suddenly find he is interested in the world rubber market as it may affect costs and therefore prices of his competitors.

Another economic aspect which will be influenced by this interchange of interests is that the rubber manufacturers will have to judge the production costs of his competitors in the plastics industry on a different basis. It was quite easy for competitors in the rubber industry to estimate each other's costs based on capital investments, overheads, labor, etc., since their equipment was more or less uniform and over a period of years, each knew pretty well what the other was doing. Now the new and often times streamlined plastics fabricators have come into the picture and it is not so easy to determine just what the costs—and therefore selling prices—may be. This misjudgment of the plastics fabricators' costs is due to the fact that there are great differences in their capital investments as well as the fact that many have only recently entered business and could take advantage of latest, more efficient equipment designs while rubber fabricators may have had to convert less satisfactory machinery.



ALL PHOTOS, COURTESY PHILCO CORP.

The ever increasing use of plastics in radios is demonstrated by this table model with plastic cabinet, control knobs, dial, dial numerals, indicator, interior parts

Plastics in four home appliances

PHILCO Corporation, one of the world's largest manufacturers of radio receivers and a leader in refrigeration and air conditioning, makes wide use of modern plastic materials in its postwar products. Company engineers have specified plastics because of their ability to meet the following criteria:

1. Freedom of design.
   a. Ability to create large one-piece sections or parts for better appearance, easier installation.
   b. Creation of special shapes and curved surfaces.
   c. Transparent qualities for use where indicators or dials must remain visible.
2. Lower production costs.
   a. No finishing required.
   b. Large one-piece molds which increase production and thereby lower costs.
3. Good insulation.
   a. Low conductivity makes many plastics ideal in interior radio, refrigerator, freezer structures.
4. Good dimensional stability.
   a. For applications requiring close tolerances.

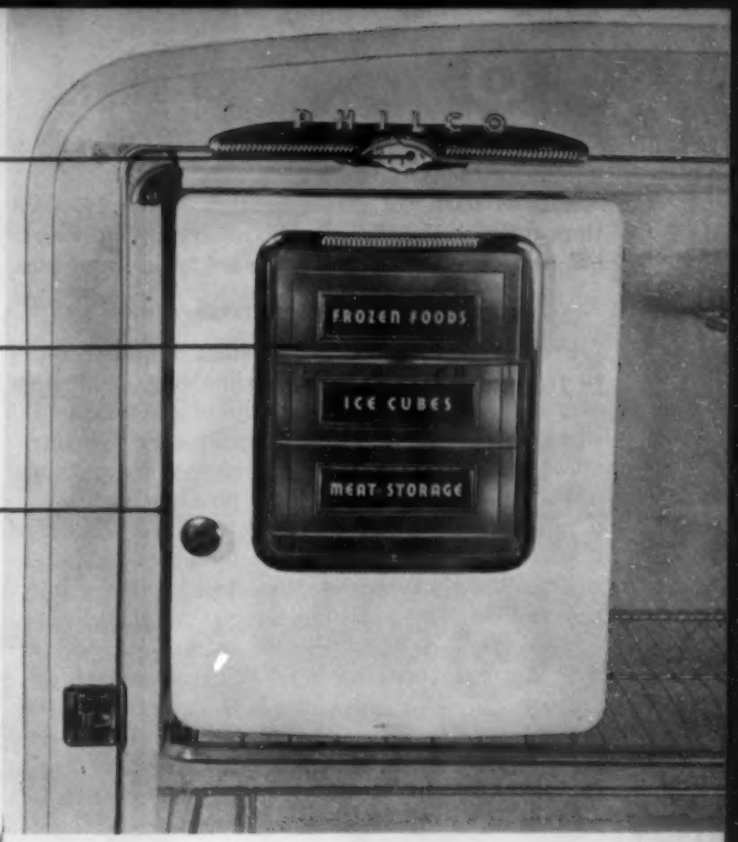
Plastics in radio receivers

Cabinets of compression molded, woodflour filled phenolic are utilized for seven table-model radio sets in the 1946 Philco line. Four of the models belong in the Transitone line, the smallest table sets; one is a farm table radio; the other two, the 420 and 420 Ivory, start the regular postwar table radio line.

In these latter two models are some of the newest applications of plastics for design purposes. The entire tuning dial and indicator is made of injected molded polystyrene. The numerals, molded in relief, are ivory filled with a maroon background. The indicator of the same material has a transparent ivory tip which reflects the light from a concealed pilot bulb. When in operation, the dial is illuminated in a novel manner.

The company's entire radio line for 1946—including 43 models ranging from the smallest table set to the largest custom-built period radio-phonograph console—is equipped with plastic control knobs. These knobs are either compression molded of phenolic or injection molded of cellulose acetate butyrate. In these last named knobs, considerable use is made of metal inlays. Both plastics are especially satisfactory because of their good dimensional stability. However, Philco engineers in many cases prefer the injection molded pieces because of the color possibilities they afford.

All push buttons for station selection are of injection molded cellulose acetate butyrate. On a number of

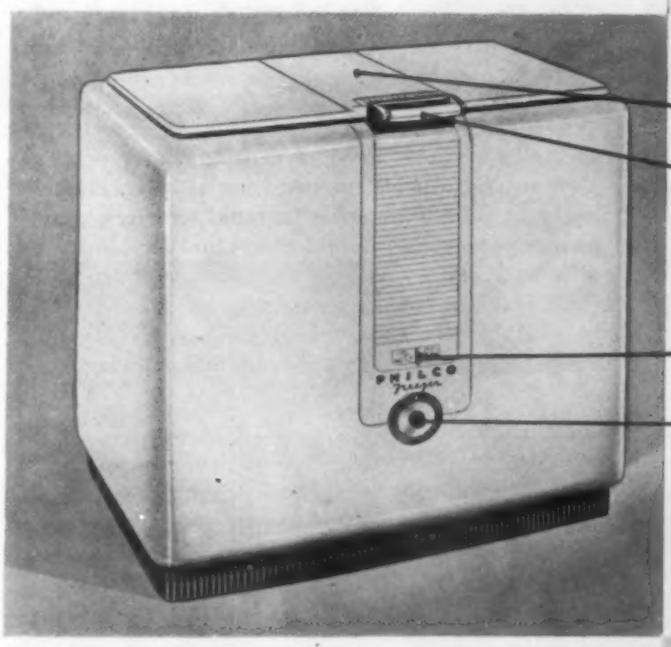


Butyrate or Polystyrene Control Knob

Polystyrene Door

Laminated Phenolic Breaker Strip

A transparent polystyrene insert in the evaporator door of some of the new refrigerators gives housewives a clear view of frozen foods, ice cubes and meat storage compartments. Laminated breaker strip on box prevents leakage of cold air



Laminated Phenolic Lid

Polystyrene Latch Handle

Acrylic Temperature Control Disk

Polystyrene Temperature Indicator Escutcheon

Chest type home freezers have a 4½ in. thick laminated lid to insure insulation in the three sub-zero compartments. A factor in its favor is its light weight, making it easy for women to lift



Polystyrene Outlet Grills

Polystyrene Controls and Escutcheon

Plastics bring added enjoyment through this single-room air-conditioner. It requires no plumbing and is as simple to operate as a radio

models, the buttons have a transparent cover of injection molded polystyrene.

Various forms of plastic materials are also used throughout the interior of radio receivers. Tube sockets, coil forms and wire covering are typical examples.

Plastics in 1946 refrigerators

Five advanced design refrigerators in both 7 and 9 cu. ft. sizes in the company's 1946 line have combination evaporator frame and breaker strips of injection molded white polystyrene. This development, which was introduced in the immediate prewar years, is being continued because of its excellent design possibilities.

In addition, the entire refrigerator line makes use of laminated phenolic breaker strips for design and insulation purposes. Temperature control knobs are injection molded cellulose acetate butyrate or polystyrene.

Two of the 7-cu. ft. models feature an evaporator door with a transparent insert injection molded of clear polystyrene. This insert affords the user a clear view of frozen food, ice cube and meat storage compartments. Interior flanges seal the frozen food compartment to prevent leakage of the extremely cold air. Plastic was selected here because the material met the criterion for freedom of design. Three other models contain an opaque rather than transparent plastic sealing cover.

Plastics in new freezers

The company's freezers will feature a one-piece breaker strip. This is made possible through use of laminated phenolic, which makes for cleaner designing.

The chest type freezers have a one-piece lid liner, $4^1/_2$ in. deep, of laminated phenolic. From the standpoint of design, the company feels this lid creates a better appearance than other accepted methods of lid construction and increases economy of operation since it is a good insulator. This plastic liner construction offers the further advantage of a saving in weight.

The chest type freezers also are equipped with a temperature control disk cover guard to prevent unauthorized persons from tampering with the controls. In order that the controls may be in constant view, though covered, the guard is injection molded of transparent methyl methacrylate. These freezers also have an injection molded polystyrene latch handle. The 5-cu. ft. model has an injection molded transparent polystyrene temperature indicator escutcheon.

The upright *reach-in* freezers feature temperature control escutcheons and temperature indicators of cellulose acetate butyrate, with a cemented window of transparent cellulose acetate butyrate for temperature readings. Once again plastics meet the desired design requirements at lower cost.

Plastics for air conditioners

The inlet grill assembly, outlet grill assemblies, control and escutcheon on the company's entire line of air conditioners for 1946 are made of injection molded polystyrene. This plastic material is used because it does not require finishing, does not corrode, reduces weight, is very stable under varying humidity conditions.

Summary

Philco engineers, while expanding the number of types of appliances they have designed for postwar customers, have made increased use of a considerable variety of plastic materials in radio receivers, radiophonographs, refrigerators, freezers and air conditioners. Plastics have been specified for these Philco products to permit greater freedom of design, lower production cost, good insulation and dimensional stability. It is likely that company's use of plastics will increase.

THE NEW SIX-CYLINDER DARRIN CAR, DESIGNED by Howard Darrin of Los Angeles, features a two-section laminated Fiberglas body, weighing 60 pounds and produced by Industrial Plastics Inc., W. B. Goldsworthy, president. A prototype of production model scheduled for early assembly is shown here. Entire front section forward of doors, including cowling, fenders and hood, head and parking light wells is formed of a one-piece laminate; turtle-deck including rear fenders is another.

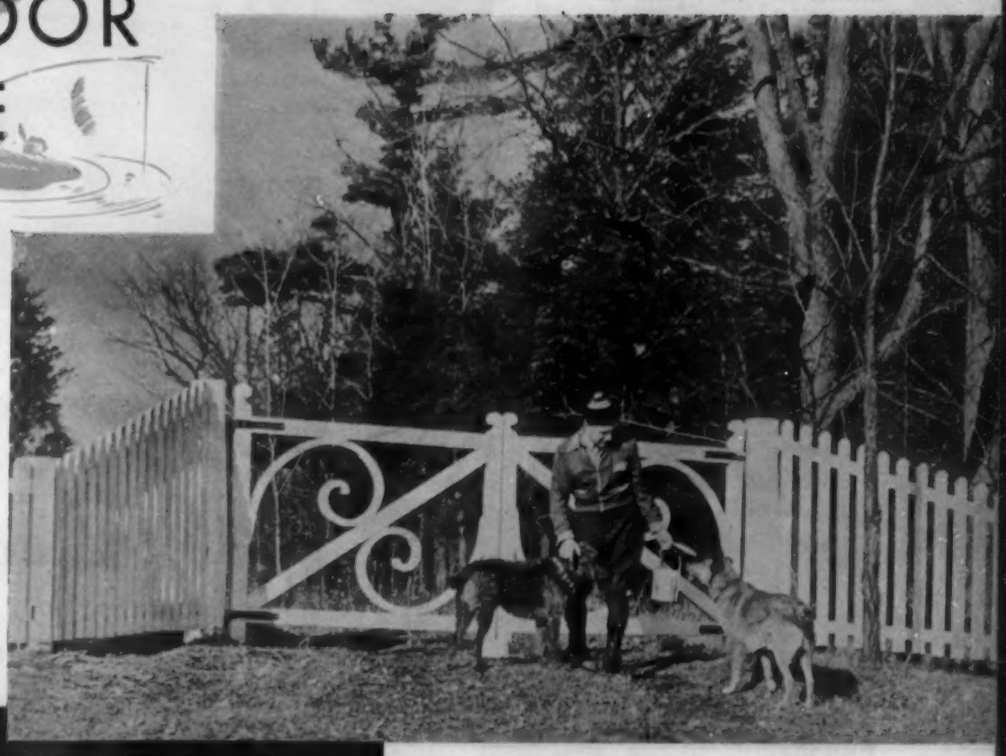


Four layers of Fiberglas cloth bonded with Selectron resin were laid up wet in large female plaster of Paris molds. Each section is laminated by photo sensitive sunshine catalyst technique and cured in sunlight. Three transverse braces are molded into forward section—aluminum tubing in inboard edge near doors, steel tubing for forward brace and cotton fiber for center brace. Impregnated cotton fiber brace conforms to flat turtle-deck section.

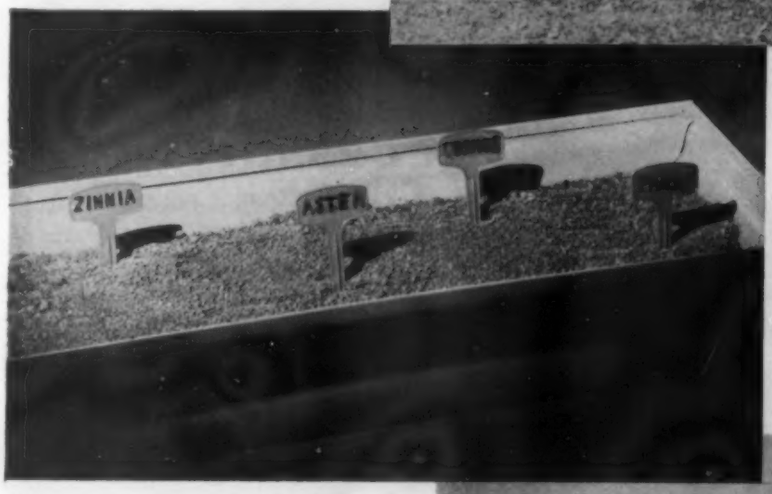
Lightweight, ease and economy of repair are among advantages of plastics. Car weighs 2400 lb. as against 3000 lb. in comparable cars.

Plastics Products

OUTDOOR LIFE



Eliminating the "fenced-in" look, this gate has laminated sections formed in artistic designs. The departure from the straight post-type gate, is made possible by laying thin strips of wood over forms and laminating them with Urac 185 resin adhesive



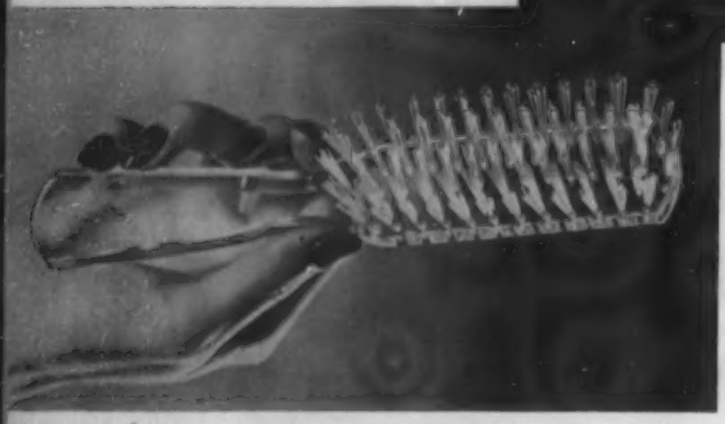
What's at stake in the garden can be clearly written on these polystyrene markers molded by Jersey Plastic & Die Co. The writing surface is roughened so that wax pencil marks will not wash or fade off in use, though they may be cleaned off for a new name. The markers are resistant to soil acids and alkalies

Hanging up real sales records is this polyethylene clothesline manufactured by Kordite Corp. The line is an extrusion of polyethylene over a strong fiber composition core and comprises two 50-ft. lengths. Easy to clean, it is said to be flexible in all temperatures and will neither sag nor stretch



In tune with the times—a radio that utilizes a thermoplastic cabinet. Molded Insulator Co. uses Hercules ethyl cellulose, Celcon and Ethocel for the 1-piece injection molded cabinet chiefly because the material is capable of supporting a floating power-type mounting of the radio chassis without cracking



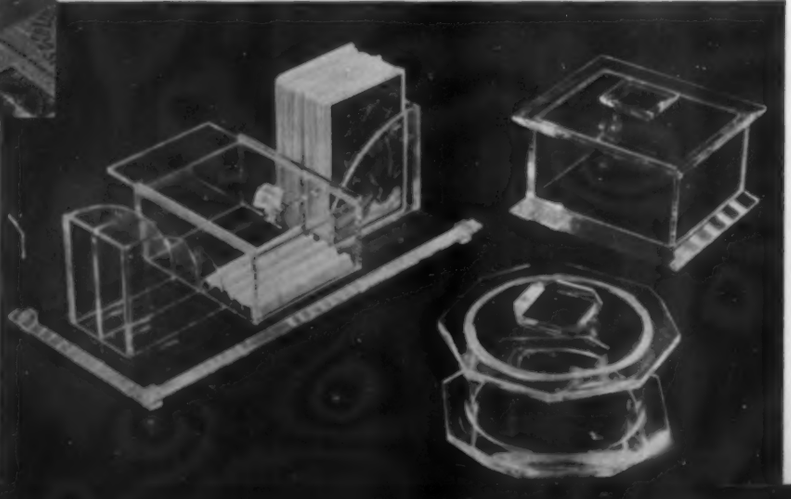


Decorative and Personal Accessories

With an eye on feminine appeal, Amity Plastics Co., Inc., makes this Lucite or Plexiglas brush with simple lines and small dimensions. Thus the brush fits any decor and can be easily handled. Nylon bristles have maximum life span



An all-Catalin ash tray of Smokerset Corp. may have an airtight ash receiver or lid of another material. National Fabricating Co. finishes cast phenolic parts



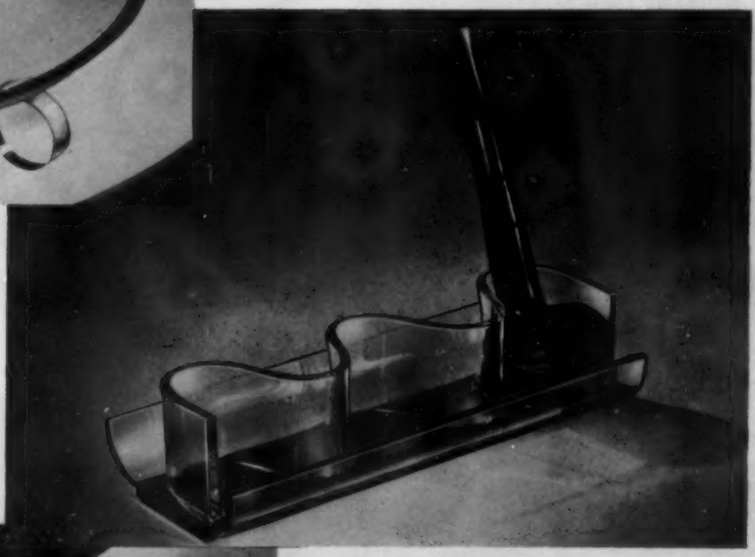
Unstinted use of Lucite and craftsmanship in its handling explain the charm of these desk accessories and novelty boxes designed by Mathew Craig for Plastic, Inc.



A reliable companion for a bon voyage—the "Shoe Pac." Shoes slipped into compartmented vinyl case are protected from other articles in the valise (and vice versa) and emerge unmarred at journey's end. Hammacher Schlemmer distributes the *pacs* in men's and women's sizes, with different colored suedette linings and bindings



Liven up a dull corner with this Plexiglas bowl made by Roberts Co. and decorated by Venus Glass Co., Inc. The design is sand blasted on the plastic and coloring applied by hand. Dye sticks only to blasted area

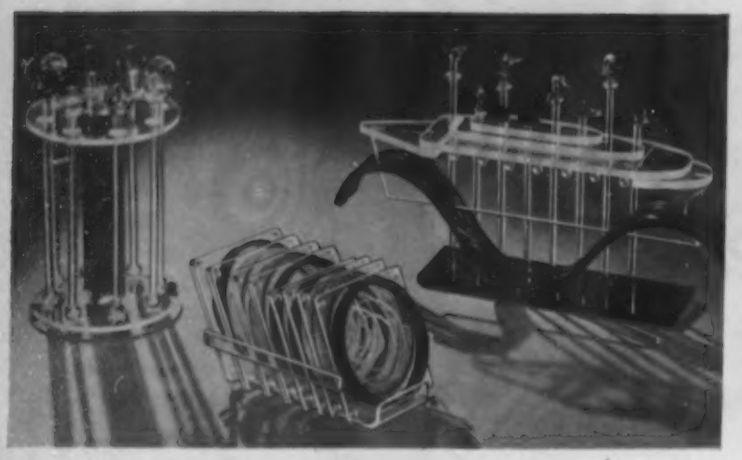


Modern lines lend beauty and practicality to this Lucite or Plexiglas pipe holder which may adorn the office desk or the den table. Fabricated by Iwano Plastic Products, this pipe holder can be obtained in red, blue, dark green and orange



Johnny Jump-Up himself can't beat cigarettes put in this novel case known as Pop-A-Cig which is injection molded of cellulose acetate by Premier Plastic Corp. Springs in the bottom release cigarettes one at a time as the metal cover is slid back. The case has compartments enough for a full pack

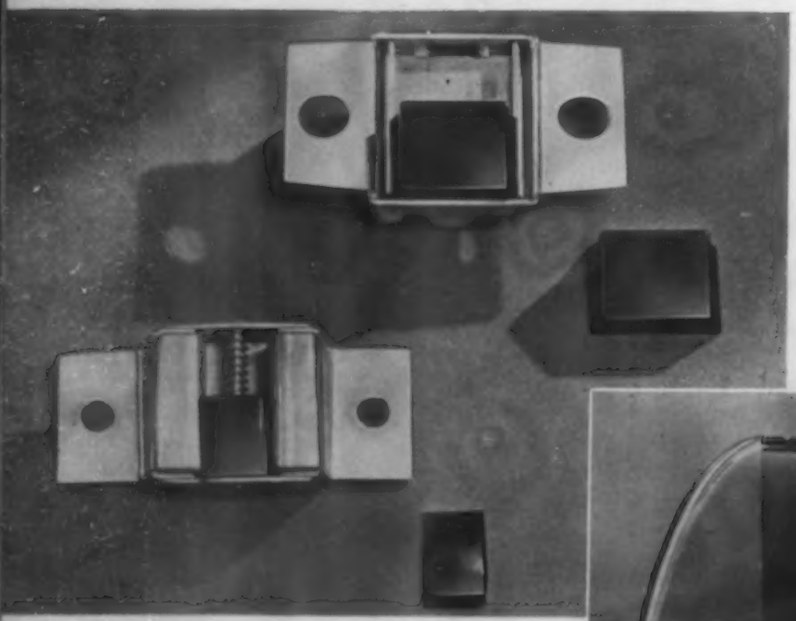
AT THE BAR



Gay gifts fabricated from Plexiglas by Plastic Art Craft include drink stirrers with lollipop tops and feet, coasters made up of colored rings and clear squares, and mixer stands like this colorful ship



One . . two . . three jiggers are doled out by this Sifon Jigger injection molded of polystyrene or compression molded of urea by Marsh Plastics and Euclid Plastics Co. for Bixler Corp.



A happy combination of metal and plastics is the self-lubricating, non-corroding automotive truck door take-up unit manufactured by Reid Products Div., Standard Products Co. Molded-in metal inserts add strength to Durez wedges

Overlooking no one, Adrian's "Saint and Sinner" perfume should appeal to all. Also appealing is its display, designed by Chas. Victor Co. and fabricated of black and clear Lucite



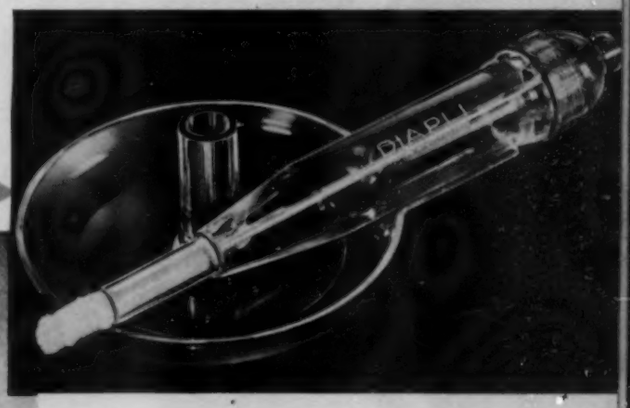
Business and Industry

Business and Industry



The wheels of this hand numbering unit go around and numbers stamp once, twice or three times! Synthane Corp. supplies the laminated phenolic wheels to the manufacturer, Wm. A. Force & Co., Inc.

A Dia-Pli applicator makes plain Jane a slick chick. The Eastern Laboratories, Inc.'s polystyrene product, molded in 3 parts by S. S. White Dental Mfg. Co. is used for hair dyeing and permanents





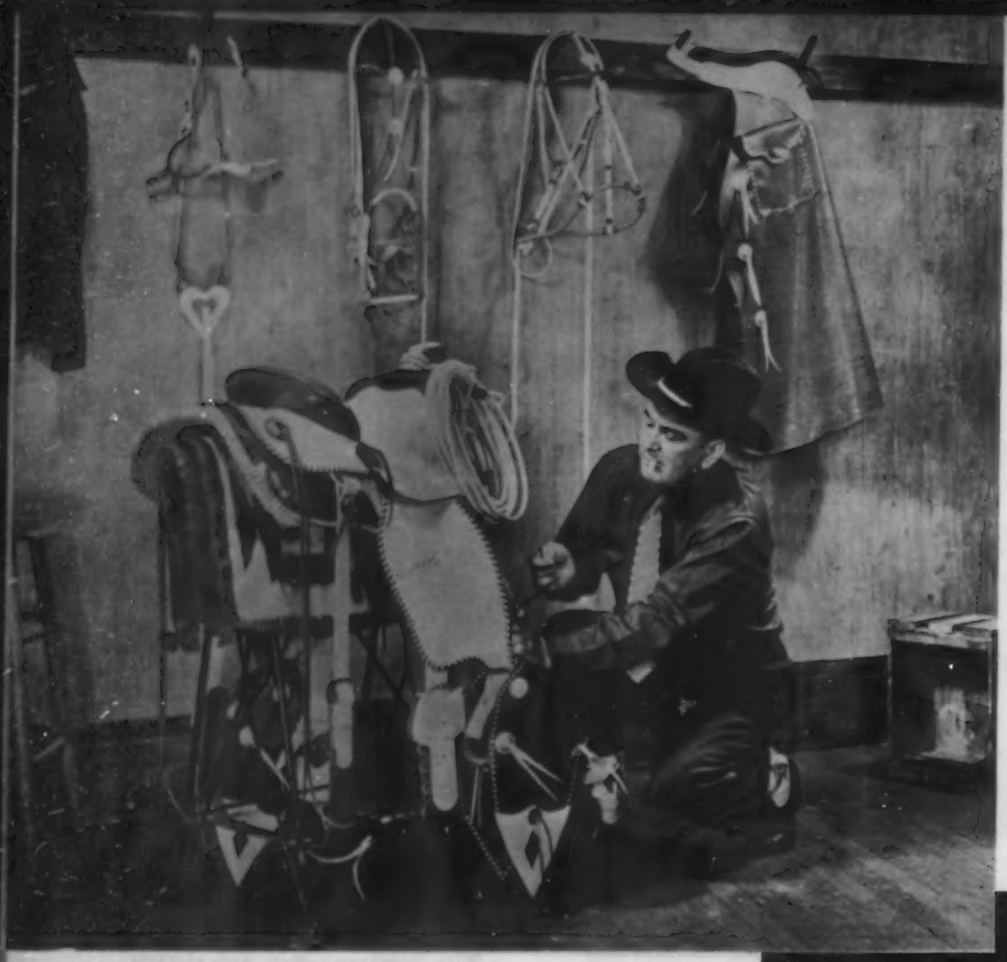
With hammer action, this electric marker put out by Ideal Industries, Inc., makes 720 cutting strokes per minute on metal, plastic, wood, porcelain or glass. The two parts of the Tenite II case are identical

Consider the dimensions to which this lily grew—3 ft. high with a span of 30 inches. Its stem and one leaf are green, the petals cream, the stamens amber—and all Plexiglas. Lynn Display Co. designed lily and papier mache rabbit



"Reserved" for the restaurateur who wants a long wearing, easily cleaned, convenient table sign. Plastic Fabricators Co. prints it on a ridged opaque Vinylite sheet over which is laminated a clear sheet of vinyl material





Cowboys may soon ride the range in Geon saddles, wearing chaps and wielding lariats of the same plastic leather. Though only in experimental production, All-Western Plastics Co. fully expects the new equestrian equipment to "take." Besides being attractive and comfortable, the polyvinyl chloride material is colorful, moisture proof, resistant to stains and to wear

PLAYTIME PLASTICS



Vacation pictures come to life in a 3-dimensional viewer, companion piece to a twin-lens camera. Tenite is used by Plastic & Rubber Products Co. in molding the sturdy, lightweight viewer for Haneel Co.



Racing fans of the junior set will enthuse over these cellulose acetate speed boats. The toy speedsters duplicate the real things and will float indefinitely. Dillon-Beck Mfg. Co. molds them in 2 pieces, cementing together with acetone. A set of 8 boats is packaged in a box that forms a yacht basin



in the nursery

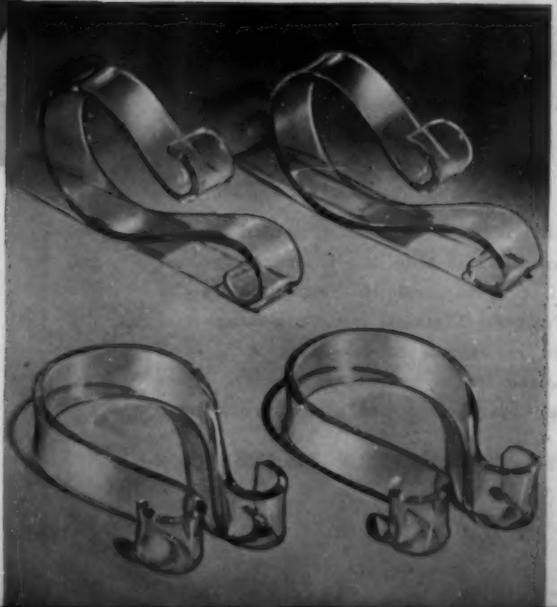
It's bottles up for baby when the Nurse-Maid holder takes a hand. The base of this mother's timesaver is molded of Nixonite by the MacDonald Manufacturing Co. for Michigan Products Co.



For the toddler who's graduated from his baby toilet seat, Herman M. Kruse & Associates distributes the larger Comfi Training Seat molded and manufactured by Hellmich Plastic Co. from black phenolic finished in white enamel or from melamine. Clip attaches it



Insects hunt elsewhere when baby frolics in this outdoor play pen fitted with a Lumite screen and marketed by L. S. Brown & Co. The screen is no bar to air and sun

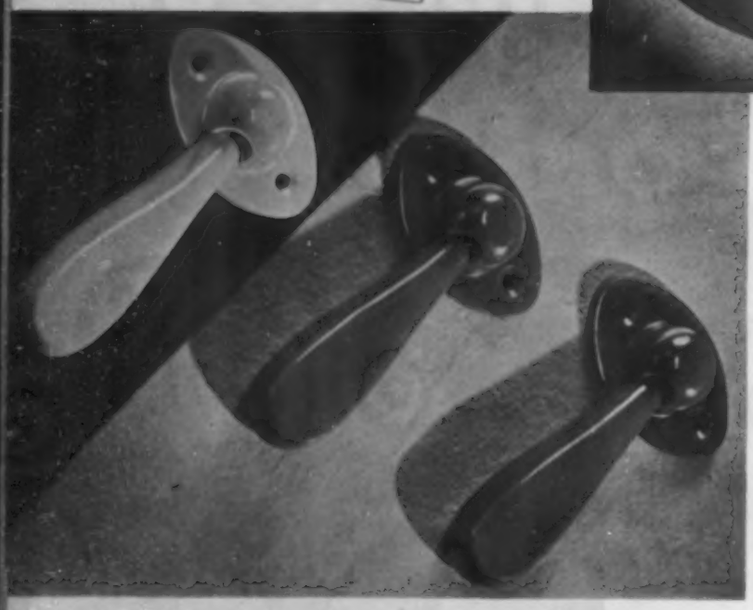


Baby's blankets are kept neat and snugly in place with Lucite clips. The plastic is well suited to these clips which must snap back in shape after being stretched over carriage rims and crib mattresses. Fairyland Plastics Products Co. fabricates the clips that have been cold-dip dyed to either dainty blue or pink

HOME UTILITY



Never too hot to handle, the 2-quart saucepan made by Bergman Mfg. Co., has handle and lid knob molded of black Bakelite. The excellent heat resistance of this material well suits it to uses like this. Sister pans are a chicken fryer, a Dutch oven and some larger saucepans



Grubby little fingers can't cause frayed edges or leave permanent stains if Priscilla plastic pulls are attached to window shades. A product of the Bee-Gee Manufacturing Co., these pulls are injection molded, 18 to the mold, and come in a wide assortment of colors. Opaque pulls are molded from styrene; the transparent pulls from Lucite



There are two reasons why these urea funnels are easy to handle. One is the insulating property of the plastic; the other is the easy-to-grasp handle. Another "new" is the sink strainer made of urea and a new type thermosetting material said to possess a high impact strength and to withstand prolonged boiling. Both items are molded by Taylor Mfg. Co.



Added to the growing list of plastic tumblers is this one injection molded of polyethylene in many colors by Tupper Plastics, Inc. Because of its resistance to breakage it is well suited to the bathroom where the percentage of dropped glasses runs high



To overcome difficulties encountered in keeping a piano tuned in a dampish climate, Irving Berlin ordered this instrument for his Bermuda home. Cellulose acetate butyrate and methyl methacrylate parts in the piano action replace wood as an insurance against absorption of moisture

Pianos that stay tuned

Improved dimensional stability and easier assembly resulted when plastics replaced wood in this piano action

A NEW type of piano action, in which molded and extruded plastic components are combined with other modern materials to produce an action which will remain in virtually permanent regulation under even the most difficult climatic conditions, has been heralded as the first major improvement in this phase of piano construction in more than a century.

The Permat action, produced by Permat Products, Inc., is a skillfully engineered precision assembly whose weather-proof characteristics eliminate many of the difficulties experienced with the conventional wooden type of action. In a series of breakdown tests under severe simulated temperature and moisture conditions, the action remained in accurate adjustment, justifying the company's claim of 95 percent permanent regulation, according to Myron A. Thayer, president of the company, who conceived the new action and supervised its detailed development.

In the past, piano actions have been made of such woods as northern maple. The principal disadvantage of wood in this application is that it is highly hygroscopic, undergoing dimensional changes with variations in room humidity which throw the action out of regulation. Then, because of uneven qualities of the wood, it is difficult to produce identical piano action parts. These problems are overcome in the Permat action through the substitution of plastics for wood in many of the components. About a dozen different types of plastic parts are contained in the action, including pieces injection molded of Tenite II by Globe Imperial Corp., a cellulose acetate butyrate extrusion made by Midwest Plastic Products Co. and hammer shanks of extruded Lucite. Action parts are assembled with brass pins, and subassemblies are fastened to the main rail of magnesium by means of screws. To provide complete coverage for all styles of spinets both a high-type installation, designed for 39 by 42-in. models, and a low type for 36 by 39-in. models are being manufactured. Of interest is the fact that the plastic action is competitive in price with those of conventional construction.

Typical of the conversion from wood to plastics is the butt and catcher assembly which in the standard piano action includes three wooden pieces assembled

with animal glue. During manufacture there are many chances for variations in the size of the parts as they go through the molding machines, automatic saws and automatic lathes. Then, in final assembly, the parts are sometimes glued together out of proper alignment. The butt and catcher leather is attached with animal glue and, due to variations in leather hides, uniformity is difficult to maintain. Since the wood, glue, cloth and leather are all hygroscopic in nature, the various components tend to come apart and strip off under prolonged exposure to high humidity.

In the Permat action, the butt and catcher assembly is of one-piece construction, the use of molded plastic reducing dimensional changes to a negligible amount and eliminating variations in parts during manufacture. For complete uniformity of holes, all are molded in with the exception of the pin hole, which is accurately drilled. Both the butt and catcher are covered with a manufactured leather which is said to outwear actual leather and is non-hygroscopic, making the entire assembly highly water- and moisture-resistant.

Similar replacement of fabricated wooden parts by molded plastic components occurs in various other parts of the action, including the whip and fly assembly, damper lever assembly and flanges. On the latter, all bushing cloth is eliminated because the plastic forms a self bearing which will outwear a cloth bearing. The damper head is molded with a countersink at the hole top so that when the piano manufacturer sets the head on the block, all necessary gluing is done simply by touching each countersink with acetone. The regulation rail and spring rail are formed of cellulose acetate butyrate extruded sections, while the main rail is of magnesium. Unlike wood, it is not affected by moisture and will neither warp nor split.

A piano shipped this summer to the Bermuda residence of Irving Berlin, famous composer, was equipped with a Permat action for protection against the unfavorable climatic conditions prevailing there. Bermuda weather, like that of all seashore locations, has long been a bane to piano owners, since high humidity and temperature fluctuations frequently cause pianos to go out of regulation. Sticky notes, double tones and generally imperfect playing qualities result.

Because of its soundly engineered combination of plastic, magnesium, manufactured leather and specially moisture-proofed coverings and adhesives, the Permat action is said to require little if any repair work during the life of the piano in which it is installed. In South America, various islands and other localities where termites destroy wooden parts, the action can be used with complete freedom from termite attack. Overwater trips to export markets will not affect the uniformity and precise performance of the moisture-proof action, the manufacturer states.

The piano owner himself is not the only person who benefits from the weather-proof construction of the Permat action. The piano manufacturer enjoys the simplified installation procedure which it makes possible, while dealers appreciate the fact that once properly regulated the action remains in that condition whether sitting in a warehouse or being used in a home.

ALL PHOTOS, COURTESY PERMAT PRODUCTS, INC.



Piano action component in close-up shows how molded and extruded plastic parts are combined with synthetic leather and other materials to produce the weather-proof assembly



PHOTO, COURTESY DUREZ PLASTICS & CHEMICALS, INC.

Unlike old type intercommunication units with open backs, this 6-sided housing is molded of phenolic in two pieces. The keys are made of clear methyl methacrylate, having slots for identification markings

All-round cabinet replaces open-back model

AN entirely new approach to the design of molded plastic cabinets has been achieved by industrial designer Joseph B. Federico in the new 1946 Belfone Maestro unit for intercommunication. Usually, cabinets of this type are molded in one piece with an open bottom or back. This intercommunication set housing, however, comprises two pieces, both molded of Durez. The front and back sections, which are molded separately, are assembled with the molded end flanges in a slot, a method closely resembling the lapped construction used in wood assemblies. Both the assembly holes and the locating pins are molded in, the molds having been developed by the engineers of the Bell Sound Systems, Inc., in cooperation with the Plastics Division of the Continental Can Company.

Besides the cabinet itself the switch for this set is plastic. Here again, Bell engineers came up with something entirely different. Designed specifically for the Maestro line, this switch is dustproof since it is completely enclosed and mounted in a horizontal postion. The keys are made of clear Lucite with slots for station identification marks. They are designed for one finger movement with a 30°-operation cycle.

In commenting upon the new design, H. E. Harris, vice-president and sales manager of Bell Sound Systems, Inc., said, "It is completely streamlined with rounded corners and horizontal bars in the modern mode. It is compact and offers many functional advantages in addition to beauty. Old intercommunication units had flat tops which became a catch-all for books, papers and other miscellaneous items that overflowed from crowded desks. Such covering of the units prevented proper heat dissipation since it acted as insulation and hindered free circulation of air.

"The rounded top of the new unit eliminates the natural tendency to pile materials on top of it. Since the many curved surfaces and encircling louvers would be impractical in wood, the cabinet is being molded of phenolic material. The unit's over-all brown-mottled finish makes it suitable for use in every type of office while the durability of the plastic means there is no more trouble from scratched and stained cabinets. One of the major advantages of the new Belfone Mixer-Master unit is the good unit-matching facilities which it provides without the need for extra parts—combining well with Selecto-Sub substations and regular wall or desk substations to fill the needs of all types of business."

The electronic circuit of this intercommunication set is brand new in design. Company engineers have eliminated completely the use of troublesome input transformers. The 6V6 power amplifier insures proper output level at any distance from the Masters, while a balanced input circuit and balanced to-ground lines of 50 ohm impedance insure full signal transmission.

Another new feature of this set is the incorporation of stand-by operation. During these periods, the filament circuit alone is on. The tubes on a master unit draw only plate current when a station is called or a substation or master calls it. This set-up results in lower operating temperatures, longer life for parts.

Salable



PHOTO, COURTESY FIORE REED CO. AND TEXTILEATHER CORP.

Left—Ideal for outdoor use, this lounging chair has a vinyl coated upholstery which is resistant not only to water but to stains as well



Right—Vinyl coated upholstery is applied to a most difficult type of chair. The one shown is designed with a deep spring cushion and requires many yards of sewing

PHOTO COURTESY TEXT-LEATHER CORP.



Left—Vinyl plastic competes economically and in wearability with any other covering for heavy furniture. Manufacturers expect wide acceptance in the home for this upholstery which heretofore was largely confined to office and commercial applications

PHOTO, COURTESY COMPREHENSIVE FABRICS INC.

PHOTO, COURTESY FANTASOTE CO.

Right—Vinyl plastics enter a reception room as coated fabric upholstery on the divan, extruded film for valence over the mirror, unsupported film for the drapes and as a coating for paper lamp shades



qualities of vinyl upholstery

THE marketable qualities of properly plasticized and processed vinyl upholstery has created intense interest in the furniture industry, and the automotive designers while cautious in their statements concerning its adoption are nevertheless beseeching processors for more and more material.

Processors and users say service tests indicate that no material heretofore available has the same ability to withstand flexing, folding and abrasion. Some might be better in one category but none in a combination of all three. A properly plasticized compound on a fabric backed sheeting has been known to go more than 1,000,000 flexings in comparison to previously used coated fabrics that flexed from 50,000 to 500,000 before breaking. In many cases the material is taken off the machine before breaking because to all appearances it could go on flexing indefinitely. On a fabric base, the cloth will frequently break before the vinyl.

However, it seems that no one is satisfied with mechanical testing in comparison to actual wear, and manufacturers are leaning more and more upon service tests —on actual use tests on a taxicab seat, for example, or on a piece of furniture that gets rough usage in semi-public places like company recreation rooms.

Age resistance is one of the vinyl's most remarkable characteristics. A specimen of most any age can be made to look like new by washing. It has been exposed to more than 800 hr. of Florida sunshine and 200 hr. of activated aging in various testing machines without showing loss of color. Cracks that are the inevitable result of aging in many other materials do not show up in properly processed vinyl at any age.

Beauty in appearance due to color brilliance and fastness, together with a distinctive, soft, luxurious feel different from that of any other material gives vinyl upholstery a natural sales appeal of the type that *needs only to be seen to be appreciated.*

Ease in cleaning should interest housewives and auto owners. The material can be washed with soap and water, and ink, grease or oil, blood, medicine, fruit juice, acids, etc., can be wiped off without staining. It is waterproof and particularly resistant to salt spray, thus peculiarly adaptable to boat upholstery and seashore cottage furniture.

A further valuable characteristic is that it will not support combustion. Vinyl will burn, but only when held in a flame. If the flame is withdrawn the vinyl stops burning. If maximum flameproofing is desired, the casting can be compounded so that it will not even burn in a flame and can be applied to a cotton base which has been flameproofed with inorganic salts.

Many upholsterers assert that both supported and unsupported vinyl sheeting are easy to work with. They say it cuts like fabric, can be easily draped and that there is little waste in the cutting process compared to that involved when cutting leather from hides of animals. Scraps can also be used for piping, trim and decoration.

An advantage for processors, too, is that practically the same formulations used for upholstery but in lighter weight, can be used for case coverings on such things as radios, musical instruments, traveling cases, field cases, kodaks and many other products. Furthermore, as soon as supply catches up with demand, it will no doubt be sold as yard goods over the counter just as Montgomery Ward sold hundreds of yards of pyroxylin coated cloth before the war.

Whether or not vinyl coated or uncoated sheeting will ever supplant leather in top grade upholstery applications is questionable because of a long standing partiality toward leather for certain uses. But there are all kinds of leathers and the less preferred types used in less costly applications will almost certainly have their difficulties competing with vinyl.

What about the cost?

Making cost comparisons is uncertain at best during these days of price turmoil, but the day is coming when prices will stabilize. Then, vinyl should have certain cost advantages. The producers are shooting for an eventual cost of less than 30 cents a pound for resin but that time may be several years away. Today, prices for vinyl chloride copolymers of the upholstery type are as low as 33 cents a pound in 30,000 lb. lots to which must be added the other compounding materials. It is probable that processors too will get their costs down after their initial development costs are absorbed and when competition becomes more acute after demand catches up with supply.

Prices a few months ago were in about the following relationship. Best quality vinyl coated fabric for upholstery on a 1.12 sateen base of 26 to 27 oz. total weight sold at from $1.10 to $1.20 per lineal yard; a 50 in. width or approximately 12 sq. ft. cost $1.10. At the same time, 9 sq. ft. of leather would have cost approximately $3.00. Best quality pyroxylin coated fabric was then running at from 84 cents to $1.00 a lineal yard. Unsupported film, 22 mils thick, in the form of embossed sheeting is now selling somewhat higher than coated fabric, but it is believed that the eventual cost will be about the same as coatings, slightly higher than pyroxylin and approximately 1/4 to 1/3 that of leather.

The present scarcity of preferred fabrics is also a factor in today's price structure. Furthermore there are literally dozens of different grades in all these materials and care must be taken not to compare a low priced grade of one material with a dissimilar grade in some other material. (*Please turn to next page*)



PHOTO, COURTESY FORD MOTOR CO.



PHOTO, COURTESY BAKELITE CORP.

Left—A convertible with red vinyl chloride coated trim for cushions and inside door panels. Right—This auto seat was covered with vinyl coated fabric two years ago, yet shows no signs of aging, flaking or stiffening. Note, that other materials used for welting and upholstery under the seat are worn, torn

Vinyl producers assert they are not concerned too much about competition from natural rubber coatings because they are not as resistant to oils, grease and perspiration as vinyl and are faced with the handicap of dull colors.

Pyroxylin coatings are expected to continue to hold a large share of their present market, according to some processors, because of the price angle and their fitness for many uses not involving severe flexing. Other processors assert that vinyl coated plastics soon will be sold at a price equivalent to today's pyroxylin prices.

Furniture upholstery

As pointed out in Part I of this article which appeared in August, so-called artificial leather has been used as upholstery since early in the 1900's. Generally it was pyroxylin, in later years, natural rubber with a fabric backing. Vinyl processors are anticipating a chance to acquire some of that market, and to enlarge it. The principal categories of furniture upholstery are:

1. Slip seats like those used on dinette chairs where the upholstery is rigid or tightly drawn. Pyroxylin coated material on 1.32 sateen or 1.85 drills has been generally used in the past and will likely continue in large measure for economic reasons.

2. The semi-rigid type such as a stiff seat with boxing that doesn't collapse, flexing taking place only where the occupant is sitting. This is also used on boxed cushions, firmly filled, that do not collapse every time the occupant gets up and down—office pull-up chairs for example. In the past the type has been mostly pyroxylin on 1.12 sateen.

3. The flexible type—collapsible boxing like on automobile or theatre seats—a spring edges cushion with an accordion-like action. This seems a new field for vinyls.

4. The pliant type—cushions filled with foam sponge or down. Examples are boudoir chairs or high grade furniture. This is a field for vinyl, other materials being too rigid or having too much body. If fabric backing is used it would probably be soft and light—perhaps napped.

It takes little imagination to see how vinyl fits into the above requirements. It is economical in cutting and easily worked, its flexibility making it easy to fashion around corners, curves and edges. It can be stencilled or printed to give a fabric-like effect which is of inestimable value for interior design in cocktail lounges, restaurants, powder rooms and places where a fabric finish is desired, but a hard surface required.

Designers believe that its beauty, utility and comparatively low cost will lead to a widely expanding use in the home furniture field where it will be ideal for occasional chairs in the den, living room, play room and library. For outdoor, porch and similar use it has the irresistible appeal of weatherproofness, mildew resistance and age resistance.

Another increasing use is as a decorative or quilted wall covering for restaurants, night clubs and even lavishly decorated homes where fireproof qualities and high color is desirable. Other uses rapidly coming into vogue are quilted or plain coverings for head boards on beds, upholstered chests of various sizes, card tables with vinyl covers and upholstered chair legs.

Used as webbing with tubular aluminum, chrome or wood, vinyl is particularly applicable to outdoor life. Designers say that webbed furniture was generally con-



PHOTO, COURTESY FORD MOTOR CO.

Pyroxylin paneling is used as an upholstery for the inside of car doors, as shown here. This application alone is a big market which the pyroxylin processors expect to hold

sidered as a stop-gap during the war when materials were scarce, but the consumers have taken to them and demand is continuing to increase.

The amount of material involved is considerable. An office or pull-up chair requires from $1^1/_2$ to 2 yd. of 20 mil material. Dining furniture requires the same amount of 10 mil material. A channel-back chair may use 8 yd. and a 3-sectional piece 17 yards.

Institutional or commercial possibilities are even more imposing in dimension. According to the 1939 census there were 123,000 barber shops in the United States and every shop has at least two chairs; there were 83,071 beauty parlors with a minimum of one chair per shop; there were 75,000 dentists and they all use chairs. Shoe stores, exclusive of department stores, numbered 20,000 and they need chairs with upholstery that will stand constant friction. The seating capacity in movies and theatres alone was more than 10,000,000. It would take a considerable yardage of upholstery to outfit them all. The Liquor Beverage Association is now putting on a campaign to convince its members that they must clean up and dress up their drinking emporiums. There are more than 100,000 such establishments—a field where stain, alcohol, and waterproof qualities of vinyl should prove remarkably adaptable.

Automobile upholstery

Hard pressed by a fabric upholstery shortage and the absence of almost all leather the automotive industry was desperate for materials in the closing months of 1945 and early 1946. Despite an unwillingness to install the comparatively new and only partially tested vinyl coated materials, these shortages forced their adoption with results indicating a wide future use.

Ease in working vinyl upholstery is particularly valuable to the auto industry where its unusual pliability is an advantage in pulling it around the corners, curves and edges of a car interior. Furthermore, its imperviousness to stain from gasoline, alcohol, blood, acid, etc., as well as the ease with which it can be cleaned by application of alcohol or soap and water are sales aids.

Uses for upholstery in the automotive trade are varied and expansive. However, not even the most enthusiastic boosters for vinyl expect it to supplant fabric in passenger car upholstery—it will only supplement the older material. Perhaps the greatest disadvantage is that vinyl does not *breathe*. Therefore, a seat upholstered with vinyl coated material becomes hot in summer and cold in winter in comparison to mohair, for example, through which the air can circulate freely.

Simulated leather in the form of pyroxylin or rubber coated fabric has, for many years, been widely used in passenger cars for purposes other than seat upholstery. Door panels are the chief item. Kickplates on the back of the front seat, arm rests, trim and bolsters for seats and seat covers are others.

One prominent old timer in the fabric coating business, when interviewed on the subject of plastic upholstery for family automobiles, declared that although vinyl coated fabric could be used for seat upholstery, women preferred fabric—and they have a large voice in determining purchase policies. However, he added, there will always be a large volume use of coated fabric for trim and flat work in the typical sedan type car. But he was skeptical of the possibility that vinyl would crowd pyroxylin out of the family car business.

The difference of opinion concerning vinyl and pyroxylin is interesting not only as it affects the automobile field but as another example of the rapidly growing competitive struggle of plastic against plastic. Both producers and processors of pyroxylin and vinyl coated fabrics used for trim and kick pads in sedans assert that their material is the obvious product to use for perfect color harmony between interior and exterior of cars.

Apropos of vinyl's use in automobiles, an interesting angle was recently presented in *Little's Industrial Bulletin*. It read as follows: "A newly designed seat has been introduced in which the usual steel springs are replaced by plastic strips covered by molded foam rubber cushioning with a plastic outer covering. This reduction in bulk reportedly provides 12 in. of available space within the car and saves weight. Material and design are said to prevent collection of dirt and to permit washing the car interior with a hose!"

Although the future looks good for expanding applications in the sedan type passenger car, vinyl suppliers expect their greatest outlet to be in convertible coupes, convertible station wagons, truck cabs, possibly taxicabs and buses because of its better resistance to flexing.

Vinyl upholstery for convertibles is especially appealing because of its waterproofness, fade resistance and color. Estimators say that a convertible will use 5 sq. yd. as minimum for upholstery. (*Please turn to next page*)

Station wagons were rapidly increasing in popularity when the war ended their production which had reached 40,000 annually. Companies are expecting to increase that figure by a big percentage and some of them have already made convertible station wagons. Without the convertible top it is estimated that one prewar model could use 26 sq. yd. of vinyl upholstery.

Upholstery in truck cabs has long been of coated fabric with natural rubber coated fabric as the preferred prewar material. But when rubber was no longer available, vinyl was requisitioned for the job and was used on all types of army vehicles with little complaint, despite the rough usage and service it had to withstand in all kinds of climates. This was probably the toughest assignment for upholstery ever known and may help to overcome the prejudice of old timers who have always felt that there was nothing as good as natural rubber coated fabric for heavy duty.

Truck manufacturers are using vinyl coated upholstery whenever they can get it and its boosters believe that performance will prove its right to remain permanently in the field. It is estimated that a truck cab would require at least 3 lineal yards of 50 in. material. The Automobile Association has reported that about 800,000 trucks will be built in 1946 and all of them require at least cushions and some form of door panel.

Bus manufacturers are so far non-committal. To date they have been using whatever they could get from wicker to leather. There are three types of buses—school, city transit and inter-urban. Coated fabric is used for school buses because of price and utility. Leather, rattan and some woven plastic is generally used as upholstery in city buses. Soft fabric is common in inter-urban buses because of comfort; coated fabric or leather being used for trim. One of the interesting developments in this line has been the installation of vinyl coated fabric for maintenance or bus repair work by one of the larger city transit companies. If it works out satisfactorily as repair material—and thousands of yards can be used for this purpose alone—the repair job may then become a proving ground to indicate that vinyl upholstery is logical material for buses.

Clear butyral coating for upholstery

Transparency, low modulus and adhesive properties are advantages of vinyl butyral for fabric coating

POLYVINYL butyral was perhaps the best known of the prewar vinyl family because of its use in safety glass. The war accelerated the development of other applications. The consequent use of this plastic in coated fabrics and, to a smaller extent, in free film, molded and extruded products, was a natural evolution.

The compound used for coating differs from that used as a sandwich for safety glass in several respects. The safety glass material employs dibutyl sebacate and 3GH, a glycol ester, as plasticizers. Consequently, numerous changes have been made in the plasticizer for coating compounds, the main emphasis being on vegetable oil derivatives such as rice and oleates. Curing or vulcanizing agents have been incorporated, these agents usually being a small amount of phenolic or other thermosetting resin added to improve the properties of the compound at elevated temperatures of around 160° F.

Monsanto Chemical Company, which is at present most active in the production of vinyl butyral for fabric coating, claims unusual properties which make this material particularly fit for certain applications.

Transparency—The first of these is transparency. The resin is basically transparent, optically clear and practically colorless. If water-white plasticizers are used, a clear coating over a printed or textured fabric is possible. The product is a fabric which hardly appears to be coated but which is waterproof, stainproof and highly abrasion resistant. Color possibilities are infinite in either transparents or opaques.

Low modulus—The second important property is a low modulus. This means that in comparison to rubber, vinyl butyral is a *dead* material and, when distorted, its recovery is slow. It sometimes gives a deceptive feel of weakness because when touched it depresses easily despite its high ultimate strength. It is this characteristic which gives an extreme softness and warmth of texture to vinyl butyral.

Adhesive quality—The third point is its natural adhesive quality which enables the processor to obtain a quick and comparatively easy bond to difficult fabrics such as glass, rayon, Fortisan, nylon and high-count cottons.

In general the physical properties of vinyl butyral have much in common with the chlorides. Abrasion resistance is at least equal to that of the chlorides although flexing strength of the butyral is somewhat less than its cousins'. Butyral will burn quite freely as compared to the chlorides which are flame resistant. For waterproofness, resistance to soaps, oils, grease and many solvents, and resistance to sunlight, oxygen and ozone, butyral is about the same as the chlorides.

Monsanto Chemical Company officials point to a war record for butyral which includes satisfactory performance of raincoats, clothing bags, flotation gear, water



PHOTO, COURTESY MONSANTO CHEMICAL CO. AND GOODALL-SANFORD

Striped fabric when coated with clear polyvinyl butyral can scarcely be distinguished from an uncoated material



PHOTO, COURTESY MONSANTO CHEMICAL CO. AND H. G. KNOLL

This modern chair employs polyvinyl butyral coated webbing, that is easily washed and withstands abrasion

bags and similar items coated with this resin. They frankly admit that some misapplications of butyral, like other plastics, have been caused by shortages of fabrics and other materials with the result that butyral has been used as a substitute in applications where it should never have appeared. Officials point out that its use should be carefully limited to those applications where its particularly favorable characteristics can be applied. It is not recommended for unsupported sheeting as upholstery.

On the other hand men in the company assert it has no peer as a transparent coating for fine upholstery, where it can be calendered or spread coated over the finest fabric. The coating imparts to even the most inexpensive fabrics a soft texture and body not usually found in coated textiles. And the fabric may be washed and ironed frequently.

The possibility of a transparent coating for a suitable fabric is something new in upholstery. It enables upholsterers to pick almost any printed figure or dyed fabric, have it coated with butyral and applied to the furniture frame just as they wish. And the housewife won't need to worry about dirt on light-colored upholstery because she can sponge off her chair or sofa with soap and water to remove any stain or spot.

The coating cannot be successfully applied to fabric with a heavy pile such as automobile upholstery nor to any other deep textured material, nor to straight acetate rayon although viscose can be coated very successfully. Heavy sheeting is recommended as the best fabric for this treatment.

No attempt has been made to enter the automotive field with this material although the Ford Motor Co. has been coating fabric with polyvinyl butyral, as well as vinyl chloride, ever since rubber became short. The first move to capture a part of the automotive upholstery market will probably be a move to install vinyl butyral coated cotton duck seat covers.

Manufacturers admit that vinyl butyral will not compete with vinyl chloride on a strictly cost basis and that butyral coaters will have to seek markets where the cost differential can be overcome by other factors. Clear butyral resin sells for approximately 80 cents a pound in comparison with vinyl chloride copolymer resins at around 35 cents or less. Spokesmen for butyral declare, however, that it is possible to use a low cost piece of fabric for coating and achieve a coated fabric upholstery material superior in many respects to a high priced uncoated fabric.

A new method of fabric treatment called transfer coating, now well past the development stage, is reported as particularly applicable to polyvinyl butyral. By this system the compound is cast on specially prepared paper and then stripped from the paper and laminated to a fabric in one operation. So far this system is particularly adaptable to thin coatings as low as one mil and unusual fabrics such as scrim and marquisette can be used, but there is nothing to prevent its use with material intended for upholstery.

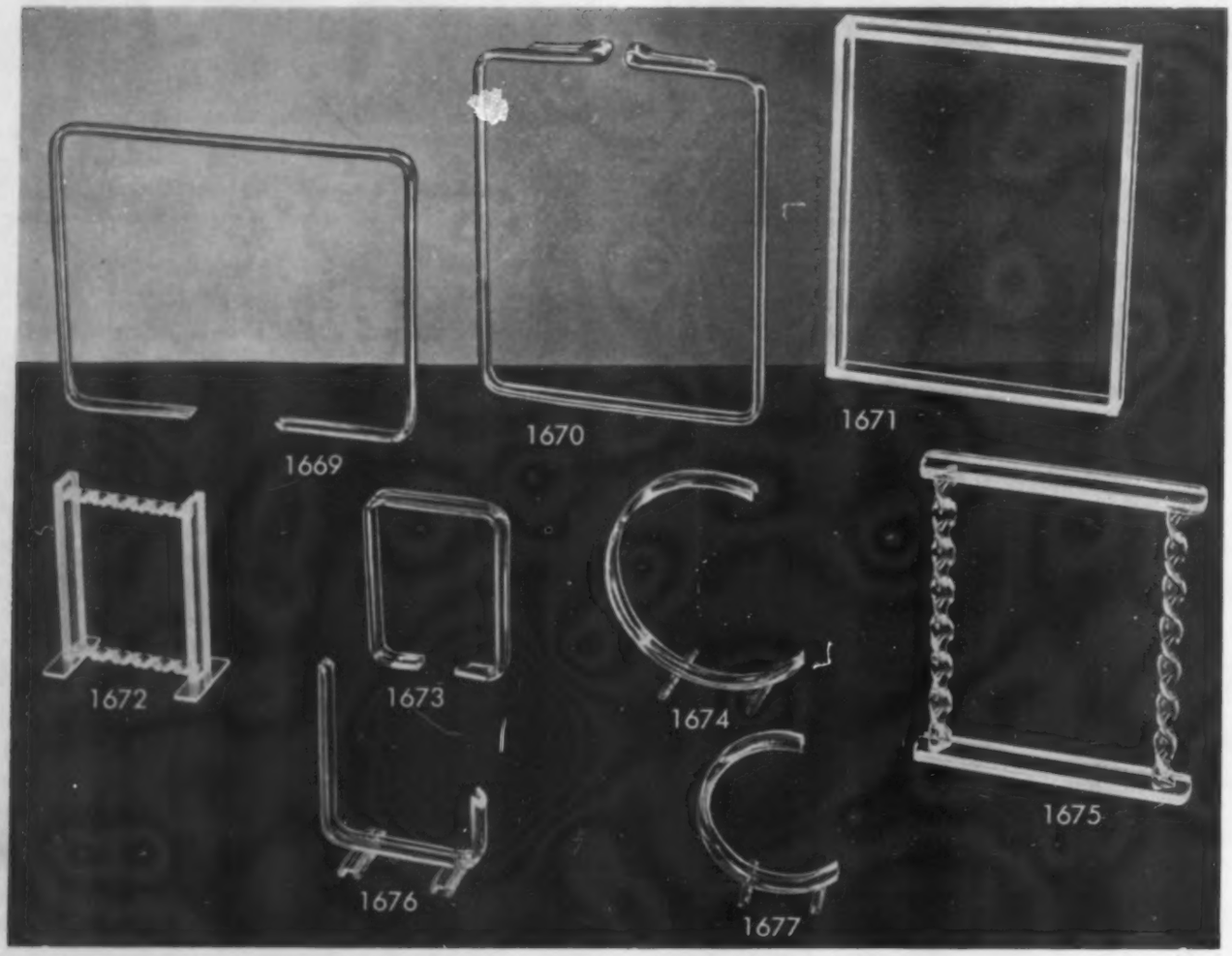
Butyral is also being used to coat webbing for upholstery which is preferred by some furniture manufacturers to unsupported sheeting. Another application is for the coating of twisted paper which is then woven into chair seats and so-called grass rugs. By this process a tissue type paper is slit into streamers 1 in. wide, wound and twisted through a cone shaped die from which it emerges in a roll about $^1/_{16}$ in. in diameter. This paper may be coated with butyral before it is cut or after it is rolled. The resulting material can be handled on weaving machines.

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Light-catching photo frames fabricated of methyl methacrylate sheets and rods, make desirable gift items. These attractive accessories will add glamour to any size picture, and are inexpensive. Additional information, manufacturers' names and addresses, may be obtained from the Stock Mold Div., MODERN PLASTICS, 122 E. 42nd St., New York 17, N. Y. Please state sheet and number.

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1669. Horizontal photo frame. Comes in the family size. 10 in. wide by 8 in. high

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1671. Box-type photo frame. 10 in. high by 8 in. wide

1672. Standing swivel-type photo frame with two plastic rests on base. 4 in. high by 3 in. wide

1673. Rectangular photo frame. 4 in. high by 3 in. wide

1674. Arc photo frame with two plastic rests on base. $5\frac{1}{4}$ in. in diameter

1675. Standing swivel-type photo frame. $7\frac{1}{2}$ in. high by $6\frac{1}{4}$ in. wide

1676. U-shaped picture stand with two plastic rests on base. $5\frac{1}{2}$ in. high by $3\frac{1}{2}$ in. wide

1677. Arc photo frame with two plastic rests on base. $3\frac{1}{2}$ in. in diameter

Plastics Engineering

F. B. STANLEY, Engineering Editor

Honeycomb core structures†

Improvement in these structures can be credited to improvement in adhesives and core materials

by O. S. TUTTLE and W. B. KENNEDY‡

WITHIN the last few years marked progress has been made in the development of sandwich laminates consisting of thin gage high strength skins which are separated by a low density stabilizing core. Two factors are chiefly responsible for this progress; namely, the development of waterproof high strength synthetic adhesives for joining the face materials to the core and the development of improved low density core materials.

Of these new sandwich laminates none has shown more promise than that known as the honeycomb type structure. For lightly loaded panels, where stiffness and weight determine design, the honeycomb sandwich is the most efficient structure yet developed. Also, the honeycomb panel may be made remarkably flat, with the dimensional stability of the metals; and it is easy and economical to fabricate into assemblies. Because of these advantages, honeycomb constructions will have wide use in industry. This is, of course, in addition to the recognized applications of honeycomb constructions in the transportation fields where some premium can be paid for weight saved.

Core structure

The honeycomb core is made of a resin-impregnated sheet material which has been cured and assembled into the form of nested hexagonal shaped cells resembling bees' honeycomb. Although any number of different types of fabrics, papers or fibrous combinations may be used, only a few of the most promising have been tested and selected for standard production.[1] These are listed in Table I together with their important characteristics.

The material selected to make the honeycomb core will, of course, be determined by the end use of the sandwich. For most commercial applications, the low-cost cotton sheeting or paper impregnated with a phenolic-type resin has been found most satisfactory. However, where electrical properties are of prime importance, a Fiberglas cloth impregnated with a polyester resin is indicated. And where fire resistance is necessary, an asbestos paper with phenolic resin would

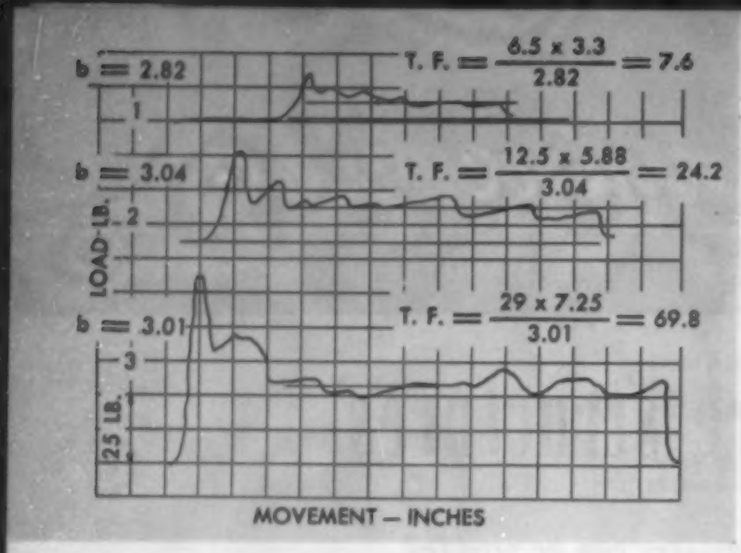
* Reg. U. S. Patent Office.
† Weldwood and Armorply (Pat. Pending) and Plycozite (Pat. Pending) are joint projects of Glenn L. Martin Co. and United States Plywood Corp.
‡ Chief engineer and structural engineer, respectively, United States Plywood Corporation.

[1] Data presented and derived from tests conducted under the direction of W. W. Troxell and H. C. Engel of the Glenn L. Martin Company.

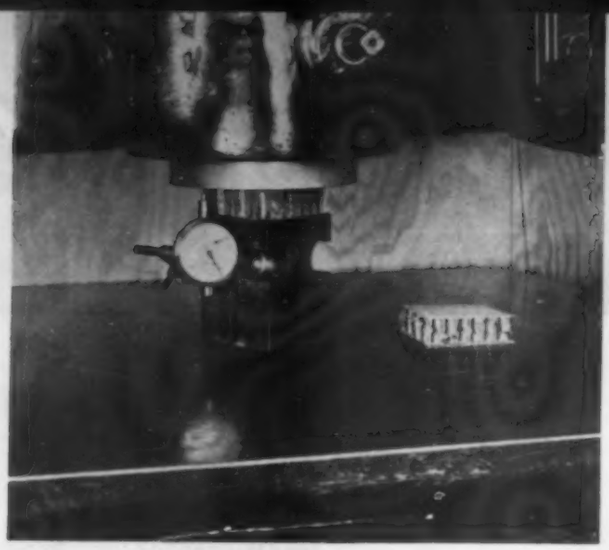


1—*By copying nature, honeycomb, the lightest weight structural core material yet known, has been developed*

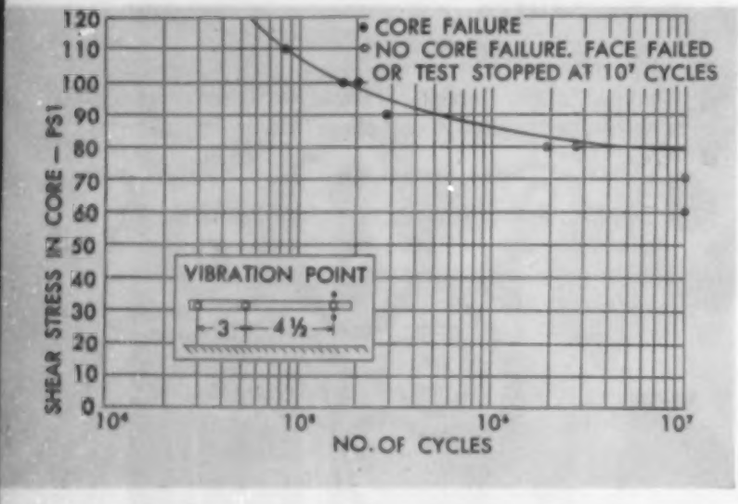
PHOTOS, COURTESY UNITED STATES PLYWOOD CORP. AND GLENN L. MARTIN CO.



2—Area under each curve is indicative of energy required to strip an 0.016 in. ST Alclad from its honeycomb core



3—Test to determine compressive strength and Young's modulus of elasticity in compression of honeycomb core



4—In these flexural fatigue tests, fatigue limit of approximately 70 p.s.i. shear stress in the core is indicated

probably be selected. Where good thermal insulation is required it is necessary to introduce an insulating material into the cell since honeycomb by itself has a K factor little better than that of solid lumber.

Table I.—Physical Properties of Honeycomb Cores

Core material[a]	*Core weight*	*Shear strength*[b]	*Shear modulus*[b]	*Compressive strength*
	lb. per cu. ft.	*p.s.i.*	*p.s.i.*	*p.s.i.*
4 oz. cotton sheeting	3.75	140	9,000	340
8 oz. cotton duck	7.8	248	13,000	710
Fiberglas cloth, ECC 128 cloth	5.75	150[c]	9,000[c]	350[c]
11 mil paper	3.5	180	17,000	360[c]
Asbestos paper	4.5	160[c]	11,000[c]	350[c]

[a] All material was impregnated with a phenolic type resin except the Fiberglas cloth which was impregnated with a polyester type resin.
[b] Parallel to Corrugations—Preliminary test results indicate that the corresponding values perpendicular to corrugations will be approximately 50% of these values.
[c] These values are estimates based on preliminary information and are believed to be conservative.

Although the optimum cell size has not as yet been determined, the United States Plywood Corp. has set up production equipment to make a honeycomb core with a $^{3}/_{8}$ to $^{7}/_{16}$ in. cell size measured across the flats. This core is satisfactory and economical for nearly all applications. However, if for structural or other reasons a smaller or larger cell size is specified, it can be obtained through special orders.

Since inserts and fittings are determined by core thickness rather than by total thickness of the panel, obvious production economies result from standardizing on a relatively few thicknesses of core. Therefore, standard thicknesses of honeycomb have been selected as follows: 0.250, 0.3125, 0.375, 0.4375, 0.500, 0.625, 0.75 and 1.00 inch.

Face materials

Weldwood and Armorply honeycomb constructions are easily adaptable to product requirements because of the wide variety of materials that may be used as facings or skins.

1. Excellent structural properties may be obtained by using thin gages of high-strength high-modulus metals such as stainless steel, aluminum and magnesium.

2. Good appearance as well as satisfactory strength properties can be had by using two or more ply decorative veneers, or high or low pressure laminated plastic sheets.

3. Excellent electrical properties are obtained using skins of laminated Fiberglas on Fiberglas honeycomb core.

4. Fire resistance may be obtained with stainless steel or laminated asbestos paper skins on asbestos honeycomb core.

The industrial designer will discover that there are many more possible combinations using decorative fabrics or other plastic laminates for surfaces.

It is important that the same material, or materials with approximately equal coefficients of thermal expansion (although different gages are satisfactory),

should be placed on both surfaces of the core to maintain a balanced construction. Otherwise, warping will result. In addition, it is probably economical to face compound curved parts with a fabric laminate since it is necessary to preform these skins, a procedure which would require expensive dies were metal to be employed.

Assembly adhesives

Because of the limited contact area, the problem of getting good adhesion between core and faces is especially critical. In fact, *this bond is the key to good honeycomb structures.*

In general, a satisfactory adhesive for assembling structural honeycomb panels must be able to withstand sustained high stress at elevated temperatures with little or no permanent creep; it must have good toughness characteristics as shown in a strip test; and it must not fatigue or deteriorate under service conditions. In addition its curing and handling characteristics should not be critical.

Plycozite, a thermosetting adhesive used in bonding metal faces to honeycomb core, was developed to meet even more exacting specifications since it is also used as a metal-to-metal and metal-to-plastic cement requiring, in addition to high and consistent shear strength, good tensile strength properties. The following tests have been developed to determine how well this adhesive or any other adhesive performs in meeting the conditions described:

1. A toughness factor for the bond is determined by measuring the energy input as a function of the time and average load required to strip the face from the core at room temperature. In this test a tensile load approximately normal to the surface of the specimen is applied to a bent-up edge of the top metal face. The head travel of the test machine is set at approximately 1 in. per minute and an autographic curve drawn until the top face has been stripped completely from the core. The toughness factor is then calculated from this curve by multiplying the average load by the horizontal length of the curve and dividing by the width of the specimen. In all cases geometrically identical specimens are tested with the assembly adhesive as the only variable. A comparison of the other structural properties of test panels with various toughness factors has indicated that a value of 15 or greater is required to insure maximum strength.

Typical autographic curves are shown in Fig. 2. The first of these curves indicates that the bond between the metal face and the core was somewhat brittle; the second curve shows results that are typical when Plycozite is used as the bonding adhesive; the third curve shows the toughness of a thermoplastic bonding agent at room temperature.

2. The test to determine creep characteristics is conducted on $^1/_2$ in. thick honeycomb panels having 0.016 24ST Alclad faces. The specimen is mounted as a cantilever beam in an atmosphere having a temperature of 160° F. Sufficient dead load is then applied to the end of the specimen to produce an average shear stress in the core of 50 p.s.i.

Specimens bonded with thermoplastic cement and tested in this manner failed after only 15 minutes. On the other hand, specimens bonded with Plycozite showed a relatively small amount of creep during the first 23 hr. but no appreciable increase was recorded in the next 42 hr. at which time the test was terminated. Tests are now underway which involve varying the average shear stress in the core, increasing the length of time of test up to several months with the load being applied intermittently, and varying the testing temperature.

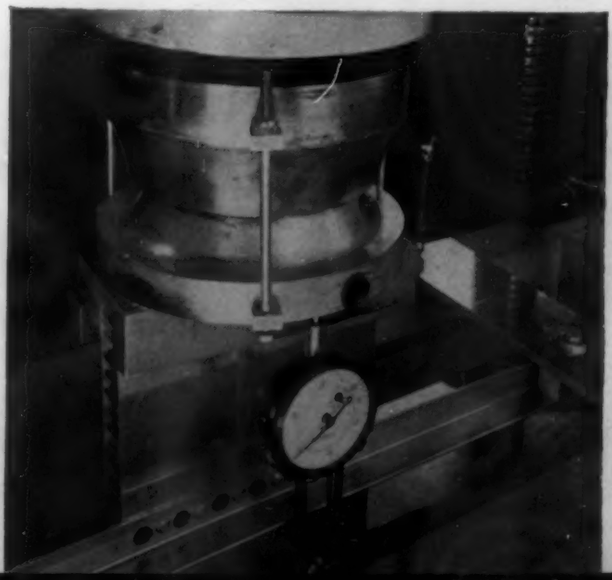
3. The shear strength of various adhesives when used to join metal to metal has been determined by bonding together two $^1/_4$ in. thick, 2 in. wide 24ST Alclad plates with an overlap of $1^1/_2$ in. and then loading in compression so as to produce a stress of 1000 p.s.i. per minute in the adhesive bond.

When Plycozite was used as the adhesive the results of a large number of tests made at room temperature were consistently good since the values when plotted showed a scatter of less than 7 percent. The ultimate shear stress averaged better than 9000 p.s.i. These

5—Short column test setup and typical examples of local failure. The yield strength is developed in these tests



6—Test of riveted splice joining two honeycomb panels. The full strength of panel was developed across splice





7



8

7—Picture frame type test fixtures used to load larger panels in shear. Panel is simply supported on all 4 edges. Load is applied along bottom edges as shown in lower left corner. 8—Example of failure when the 20 by 70 in. panels were tested in shear

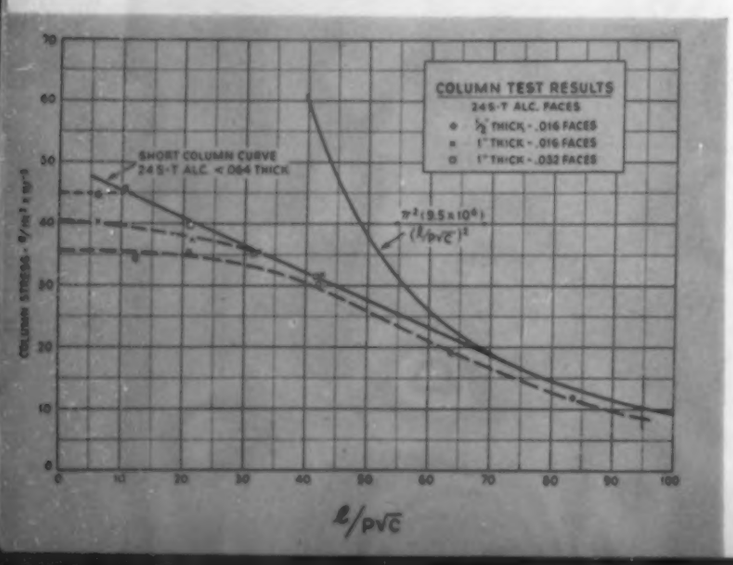
same tests were repeated at 150° F. when the shear stress was reduced to a minimum of 6000 p.s.i.

Tests were also run on specimens bonded with the best commercially available (at the time of test) metal-to-metal adhesive. This adhesive indicated ultimate shear stresses of 5700 p.s.i. at room temperature and less than 3000 p.s.i. at 150° F.

Results of investigations

Accelerated weathering tests—Because the ability of the honeycomb types of construction to stand up under the effects of weathering is very often questioned, an accelerated weathering cycle has been established for the purpose of obtaining data in a relatively short time. This cycle consists of 16 hr. at 120° F. and 100 percent relative humidity, 4 hr. at −50° F., and 4 hr. at 160° F. It is repeated once a day for 5 days followed by 2 days at 120° F. and 100 percent relative humidity. Samples are removed and tested once a week over a period of 12 weeks. These samples are checked for dimensional change and weight change as well as for column compression strength and flexural stiffness.

9—These column compression curves indicate the way in which the test results compare with the theoretical values



At the end of the 12-week period the shear strength of the core and the toughness of the bond is determined. Although a metal-faced honeycomb core panel which has its edges sealed with some type of edge banding may rightly be expected to behave as well as the metal under similar conditions, the tests have all been run on specimens without edge banding. Table II shows typical data from one group of test specimens bonded with Plycozite adhesive.

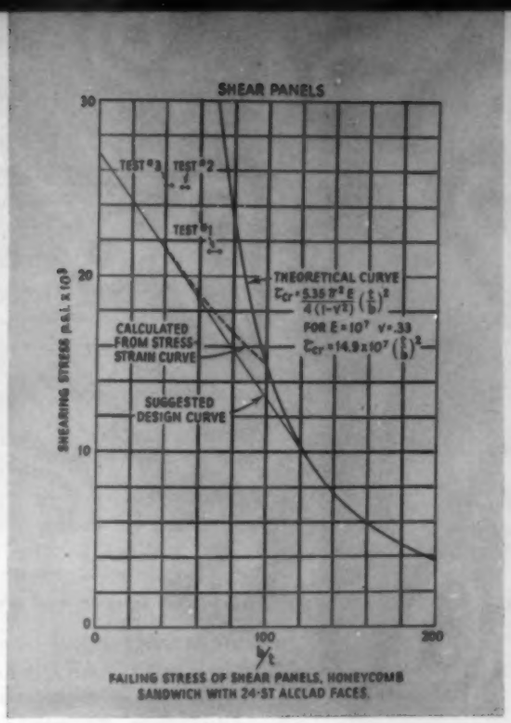
Table II.—Accelerated Weathering Tests: Typical Test Data

No. of weeks	*Weight*	*Thickness*	*Deflection at 80 lb. load, 10 in. span*	*Col. compression; ult. stress in faces*
	grams	*in.*	*in.*	*p.s.i.*
0	74.4	0.525	0.046	39,800
2	74.5	0.525	0.046	33,800
3	74.3	0.526	0.047	32,100
4	74.3	0.526	0.045	35,400
5	74.0	0.526	0.045	36,000
6	74.3	0.526	0.045	32,500
7	74.1	0.526	0.046	32,000
12	74.5	0.526	0.046	35,500

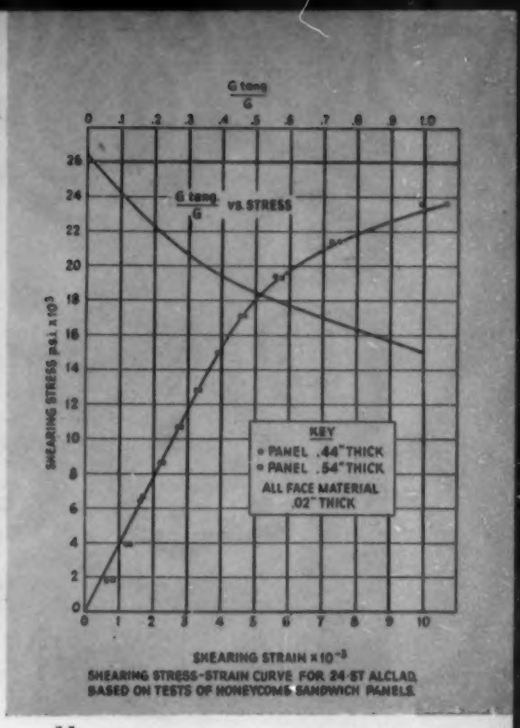
Service data are being accumulated from installations. However, the information presented in Table II should be quite reassuring not only from the standpoint of the honeycomb core but also from the standpoint of the Plycozite adhesive which is used to join the faces to the core.

Effects of water immersion on core and cement.—Another indication of the ability of both the honeycomb core and the Plycozite to withstand extremely severe conditions is afforded by results which were obtained by immersing in water at room temperature a group of ½ in. thick honeycomb specimens using standard core faced with 0.016 in. 24ST Alclad, none of these specimens being sealed along the edges. At the end of 3 days and at the end of 7 days while still wet, tests were conducted in bending over a 6 in. span

10—*This shows ultimate stresses plotted and compared to theoretical curve calculated for infinitely long panel.* 11—*Curve of shearing stress versus shearing strain and curve of G tan/G versus stress are shown plotted here*



10



11

Table III.—Typical Data Obtained from Water Immersion Tests

Condition of specimen	*Shear strength of core*[a]	*Toughness factor (peel test)*	*Modulus of rigidity of core*
	p.s.i.		*p.s.i.*
Original state	174	39.0	10,750
Immersed in water for 3 days and tested wet	132	39.6	6,820
Immersed in water for 7 days and tested wet	122	43.4	6,670
Immersed in water for 7 days, then dried at 160° F. for 3 days	154	24.9	10,150

[a] All failures in the bending test to determine shear strength were in the core, none occurred in the cemented joint between faces and core.

Table IV.—Flexural Fatigue Tests Results on Metal-Faced Honeycomb Core Panels

Panel construction	*Stress in faces*	*Shear stress in core*	*No. of complete reversals*[a]	*Description of failure*
	p.s.i.	*p.s.i.*		
3 in. wide, 10 in.	12,200	60	10,000,000	No failure
long, 1/2 in.	12,350	70	10,107,000	No failure
thick, 0.016	14,100	80	2,713,900	Failure in Alclad face
24ST Alclad faces	15,000	80	1,913,800	Failure in Alclad face
	16,900	90	289,900	Failure in core and adhesive
	18,750	100	204,900	Failure in core
	20,600	110	84,900	Failure in core

[a] Vibrated at a frequency of 1800 cycles per minute using a constant stress-type fatigue machine.

to determine the shear strength of the core and its modulus of rigidity. The effects of this treatment on Plycozite were investigated by subjecting the bond to the strip test to determine toughness. A duplicate set of panels were removed from the water after 7 days then dried for 3 days in an oven at 160° F., and then subjected to the same test. Results of these tests are given in Table III.

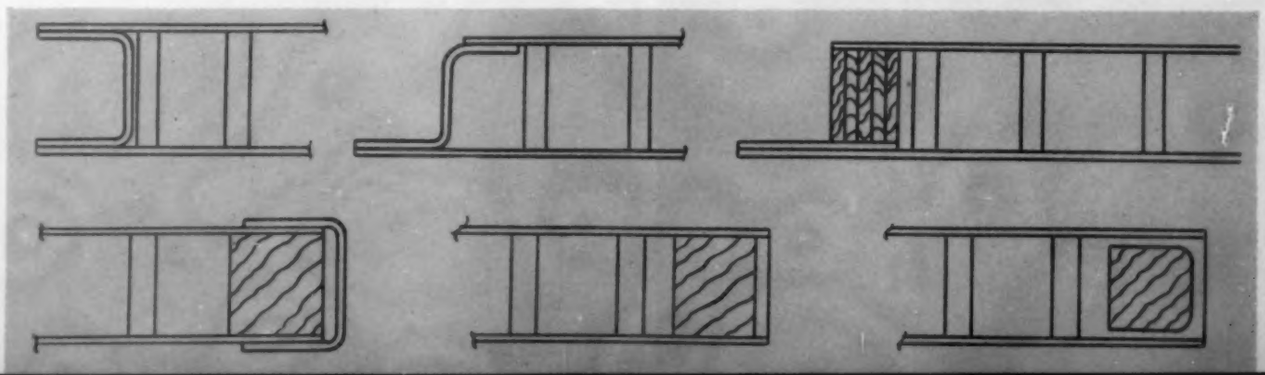
Fatigue characteristics.—Fatigue characteristics of metal-faced honeycomb core panels bonded with Plycozite have been determined and the results are summarized below:

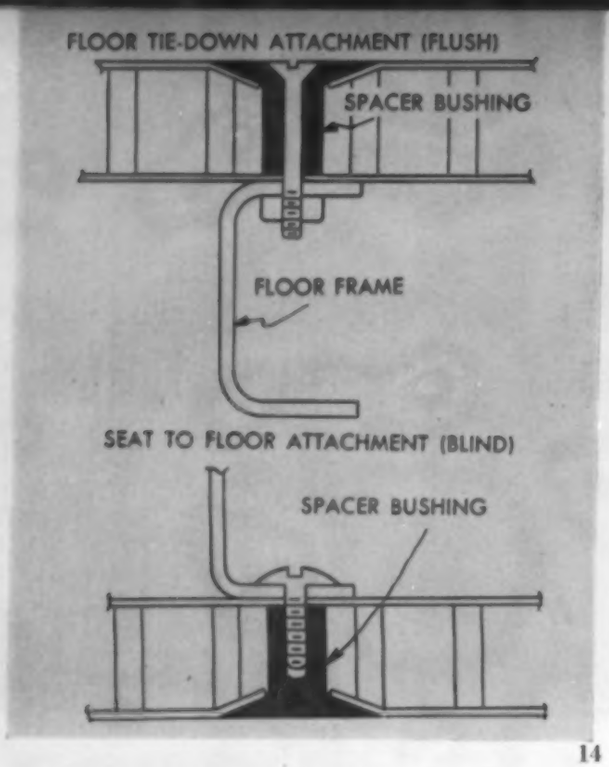
1. Panels 24 by 24 in. withstood conventional 25-hr. shaking table tests without any effects.

2. Flexural fatigue tests indicate a fatigue limit of approximately 70 p.s.i. shear stress in the core. This is considered satisfactory since shear stresses of this magnitude are not experienced in typical high strength applications where repeated loads must be designed for.

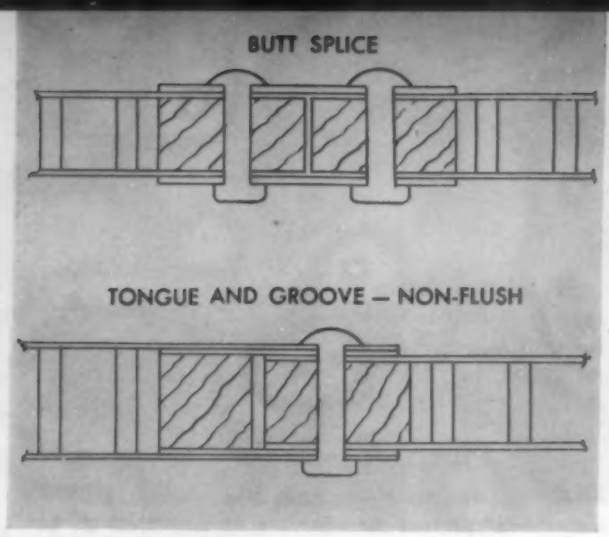
The results of flexural fatigue tests are tabulated

12—*Typical edge banding details which can be used to reinforce edges and seal honeycomb core are shown. The materials often used are wood, plastic, aluminum extrusions, solid aluminum*





14



13—This drawing shows methods for making a butt splice and tongue and groove splice when joining panels

14—This drawing shows graphically two methods, out of many, of attaching honeycomb core panels to a support

in Table IV and an S-N curve is plotted as Figure 4.

Design criteria

Honeycomb core structures are classified as plates and can, in general, be handled with the existing plate theories. However, the use of the honeycomb core introduces other considerations that are not critical in a solid homogeneous plate. In a loaded sandwich structure the core should satisfy the following requirements:

1. It should hold the faces apart by resisting loads normal to the plane of the plate.
2. It must act as the shear carrying element between the two faces.
3. It should stabilize thin faces against local buckling at low stresses.

The honeycomb type of core carries no load in the plane of the plate nor does it add anything to the flexural stiffness (EI) of the panel.

Laterally loaded plates

1. *Deflection*—The determination of the deflection of a laterally loaded plate offers no problem if account is taken of the shear modulus of the core. A shear deflection is calculated in the conventional manner and is added to the bending deflection as determined from the proper plate equation. In many cases this additional increment of deflection will be negligible and in no case will it be the major part of the whole.

2. *Ultimate strength*—There are three types of failure that may take place in a laterally loaded plate: a) shear failure of the core, b) compression failure of the core, c) failure of the faces. The first two are the result of the load on the plate being such as to exceed the ultimate shear and compression strengths of the strengths of the core as listed in Table I. In the third case, the faces may fail in either tension or compression due to the bending stresses developed.

Since the shear modulus of the core does not effect

Table V.—Typical Flexure Test Results of Honeycomb Core Sandwich

Specimen no.	*Thickness of face*	*Thickness*	*Width*	*Span*	*Ult. load*	*Shear stress in core*	*Stress in faces*	*Modulus of rigidity*
	in.	*in.*	*in.*	*in.*	*lb.*	*p.s.i.*	*p.s.i.*	*p.s.i.*
2751–6	0.017	0.487	2.98	20	204	76	44,400	10,630
" –7		0.483	2.99	15	256	95	42,000	9,900
" –8		0.482	3.03	10	396	146	42,900	10,590
" –9	(24ST Alc.)	0.495	2.99	6	477	173	30,400	9,440
" –18		0.480	3.00	6	470	175	31,000	9,860
" –19		0.482	2.98	6	479	176	31,600	
2753–6	0.0165	0.946	2.98	20	426	78	47,500	10,360
" –7		0.944	2.98	15	560	104	46,900	10,630
" –8	(24ST Alc.)	0.944	3.02	10	790	144	43,500	10,400
" –9		0.947	3.03	6	775	140	25,500	9,950
2754–6	0.0335	0.967	3.00	20	720	133	39,800	9,610
" –7		0.968	3.00	15	750	139	31,000	9,260
" –8	(24ST Alc.)	0.970	2.98	10	790	147	21,900	10,960
" –9		0.977	3.02	6	800	146	13,050	10,420

the stresses in the faces, they may be calculated in the ordinary manner if the moment of inertia used is the moment of inertia of the faces alone about their combined neutral axis. Although the present data indicates high failing stresses for all materials, most of the available test data are for honeycomb core faced with aluminum alloy skins. Typical results are listed in Table V.

Plates loaded in their own plane

There are three principal types of structure that fall into this classification: 1) Columns, 2) Plates supported along the unloaded edges, 3) Shear panels. Each of these types is subject to failure by instability in the large or local failure of the faces.

1. Instability failure—The theories for these three types of structure are well known. The buckling stress in each case is proportional to the flexural stiffness (EI) of the plate, which, in the case of the honeycomb core, is calculated using the face material alone. Here again the actual failing stress can be affected by a low shear modulus of the core. This may necessitate modification of the basic expressions in some cases in order to include this effect. However, the results of investigations on columns show that this need not be done when the shear modulus of the core is in excess of 10,000 p.s.i. The rather close agreement of the test results with the column curve of the face material shown in Fig. 9 bears this out, for the shear modulus of the core in these cases was approximately 9000 p.s.i.

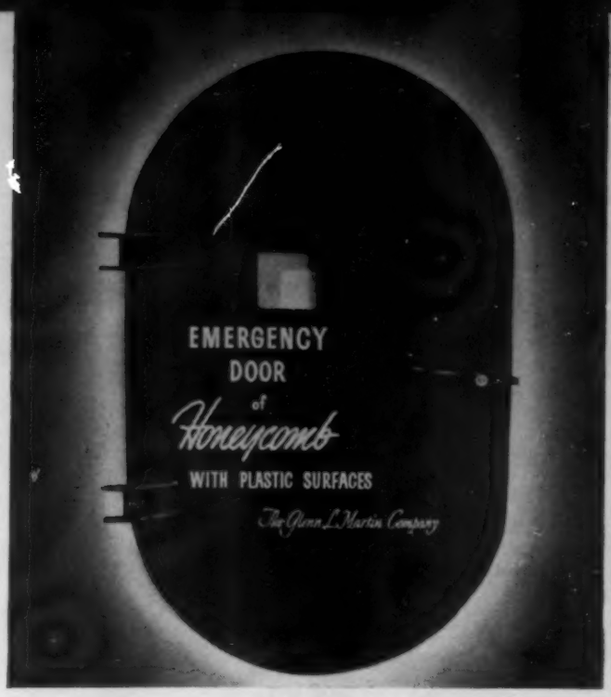
Preliminary test results on shear panels have also been obtained which indicate high strength characteristics for this type of application. Three panels, 20 by 70 in., with 0.020 24ST Alclad faces were tested in shear with the following results (see Fig. 7):

Thickness of panel, in.	*Shear stress in faces at failure, p.s.i.*
0.340	24,000
0.440	26,000
0.540	26,000

In all cases failure was in form of diagonal buckle across panel (Fig. 8). Figure 11 shows curve of shearing stress versus shearing strain which was obtained during these tests by means of Rosette gages placed on the faces of the panels. This curve indicates a value for the shear modulus of 3.85×10^6 p.s.i. which is almost exactly the true value for 24ST Alclad. From this curve it was possible to calculate the curve of G_{tan}/G versus stress which is also plotted in Fig. 11. The ultimate stresses are plotted in Fig. 10 where they are compared to a theoretical curve which was calculated for an infinitely long panel simply supported along all four edges. Actually the plate had an aspect ratio of $3^1/_2$ to 1 and there was a certain amount of restraint along the edges. Both of these facts account for the test points being higher than the curve.

2. Local failures—There are two types of local failure which may occur in this type of construction: local buckling of very thin metal faces into the cells, and short-wave buckling of the faces away from the core.

The first of these is not really a failure but a decrease in the efficiency of the faces. Thus, when failure does occur the average stress on the faces is less than would be obtained with unbuckled faces. The critical skin thickness will vary with the metal used and the cell size of the core .Using (*Please turn to page 194*)



15—An access door made with a honeycomb core construction. Lightweight, high strength make it desirable

16—An alclad skin is laid upon a honeycomb construction before bonding under pressure and temperature





17—Another example of uses to which honeycomb core construction can be put is shown by this airfoil section

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Laminated edge attachment for acrylics*

Preliminary tests indicate that this type attachment is at least twice as strong as conventional means of attachment where holes are drilled in the acrylic

by E. H. SNYDER†

AN EXAMINATION of a number of service reports on large acrylic airplane parts such as canopies, astrodomes, turrets, blisters, noses and windshields, revealed that replacements were comparatively frequent and most of these were necessary due to crack formations originating at attachment points. The method of edge attachment assumed a role of increased importance with the introduction of high-performing aircraft such as the P-80 airplane for the aerodynamic and cockpit pressure loads encountered in the plane imposed still higher loads in the acrylic material used in the canopy.

The present conventional method of attachment requires the drilling of a considerable number of holes along the edges of the canopy. These holes have to be large enough to permit the installation of rubber grommets and steel liners which serve to minimize the possibility of crack formation. A new and improved method of edge attachment was recently developed which consists of integrally bonding a laminate of relatively high strength to the canopy edges. Attachment can then be made directly through the laminated edge strips without the need of resorting to the use of grommets and liners.

Until recently the manufacture of such a reinforced edge has not been practical. However, with the development of catalysts which promote rapid polymerization or solidification of the methyl methacrylate liquid monomer in the presence of ultra-violet light, the bonding of edge strips to the canopy has become feasible.

Preliminary tests indicated that this type of attachment was at least twice as strong as the conventional edge attachment. Thus a series of tests was instigated to develop a design and technique which was commercially applicable to regulation canopies. The final objective of this program was to apply the new attachment method to actual airplane parts such as canopies and windows and determine their strengths when tested under conditions encountered in the actual flight of the airplane.

Discussion of laminating resins

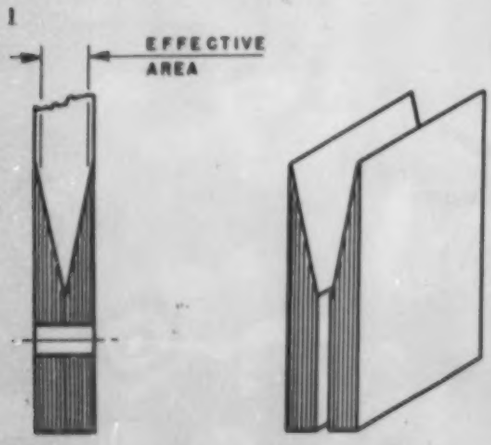
The acrylic sheeting used in present-day aircraft is made by casting methyl methacrylate monomer (a water-white liquid) between two glass plates. The addition of a catalyst and the application of closely con-

* Presented at the Annual West Coast Aviation Meeting of the American Society of Mechanical Engineers in Los Angeles on June 3 to 6, 1946.

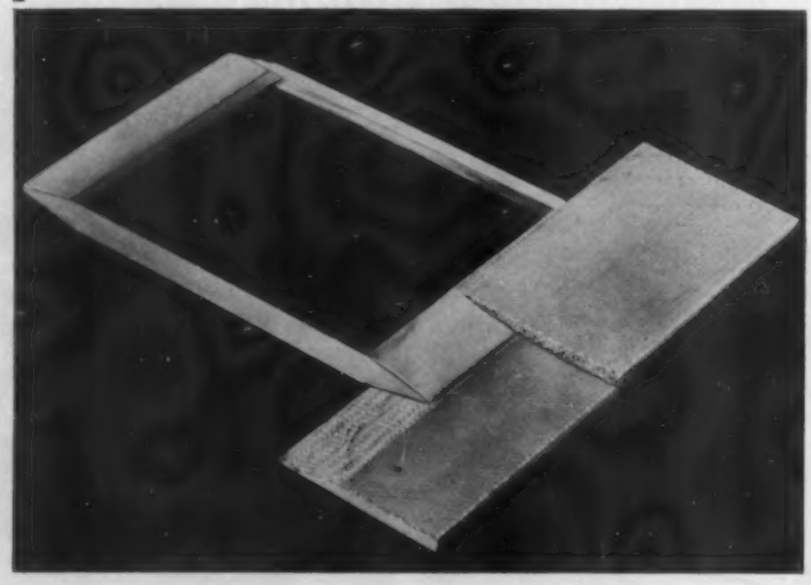
† Research engineer, Lockheed Aircraft Corp.

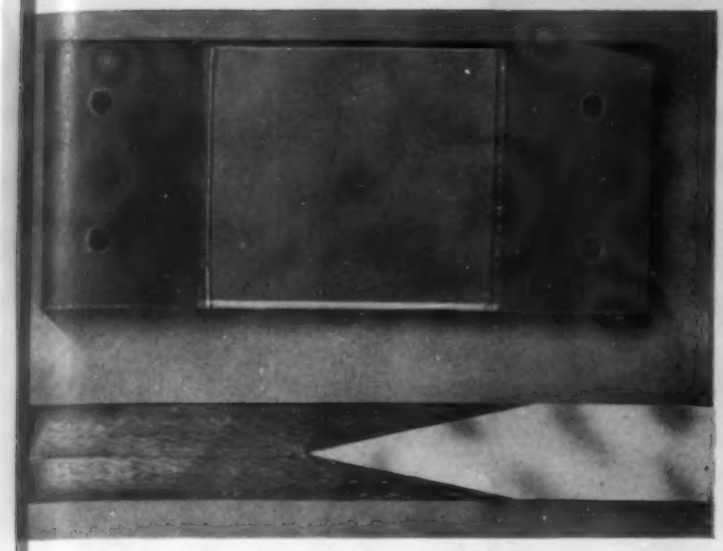
1—*Some of the first acrylic tension specimens contained an external "V" shown here.* 2—*This picture shows the method of attaching the cured edging to the external "V" joint*

1



2





3—Beveled strips are placed together to form a mating "V". Successful rapid machining of strips is accomplished by using cutting tools with cemented carbide tips



4—Here is preliminary external "V" joint, laid up wet with individual laminae, before and after trim. Problem is to avoid loose threads and the handling of wet laminae

trolled heat cause the monomer to polymerize or cure into a solid state. Polymerization is accompanied by an exothermic reaction which, if not properly regulated, would cause the rate of polymerization to progress beyond control and result in the formation of bubbles or perhaps violent boiling of the monomer. This is reviewed in order to point out that polymerization must proceed at a rather slow rate. Several days or a week, depending upon the thickness, is necessary for the curing of the usual cast sheet.

When attention was first directed toward a laminated edging for acrylics, it was conceivable that layers of cloth could be cast integrally around the edges of a cast acrylic sheet. This, however, was beyond the scope of the average aircraft plastics laboratory. It was hoped that a quicker and more practical method could be developed to integrally attach a laminated edging to methyl methacrylate sheeting.

A light-sensitive catalyst,[1] which caused strips of cloth impregnated with prepared acrylic monomer to *jell* in 5 to 10 min. and cure into a hard mass in approximately one hour of exposure to sunlight, appeared to be the solution to the problem of the laminated edge attachment.

Methyl methacrylate monomer is water-like in consistency. To make it more suitable for laminating operations, it was thickened or bodied so that it would not run off the laminated or bonded item before the polymerization or solidification reaction was complete. The monomer was bodied or partially polymerized by adding a very small amount (0.2 percent by weight) of the light-sensitive catalyst and refluxing until the suitable viscosity was attained. Care was exercised in determining the amount of catalyst necessary so that none in excess of the specified amount would be added. Too much catalyst would cause the exothermic reaction which occurs during refluxing to proceed so very rapidly that uncontrollable boiling results in complete polymerization.

When this bodied resin cooled to room temperature, an additional 3.0 percent by weight of the catalyst was added to make it ready for application. In this condition it must be used within a few hours or stored in a refrigerator to prevent complete solidification or polymerization.

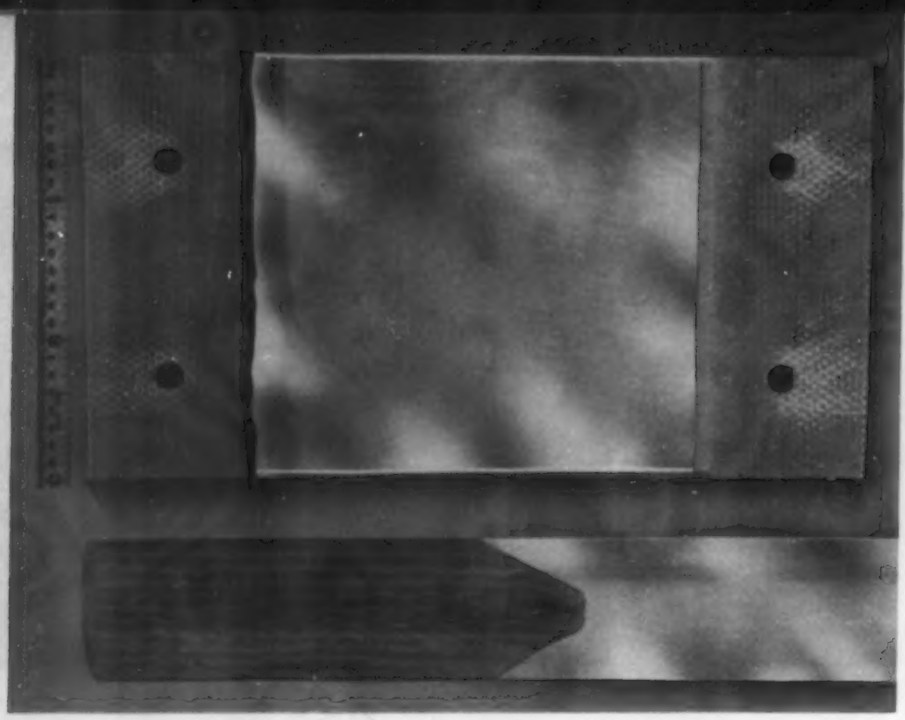
Fabrication of joint specimens

The test specimens used to determine the strength of the various types of edge attachments were made from $^{5}/_{16}$ in. thick acrylic sheet stock $4^{1}/_{2}$ in. long and 3 in. wide. The thickness and width were thus chosen to approximate 1 sq. in. of cross-section. The laminates used for the edges of the new type joints consisted of Fiberglas or other fabrics laminated with the same synthetic resin that is used for making the actual blown airplane canopy.

Type I—external V joint—Some of the first acrylic tension specimens, containing an external *V* on the ends (Fig. 1) were prepared *wet*; that is, laminae of glass cloth, which had just been dipped in the acrylic resin, were laid symmetrically on either side of the scarfed ends and the whole assembly sandwiched between cellophane-covered glass plates. After exposure to sunlight for approximately an hour, the resin polymerized or cured, and the specimen was then ready for trimming and mounting. It has been found that the time necessary for curing can be substantially reduced by using a good strong source of ultra-violet light instead of natural sunlight.

Since cut glass fiber cloth tends to fray and become

[1] Manufactured by C. C. Sachs.



5—Internal "V" joint is made by bonding cured laminated strips to prepared acrylic edge but laminate in this case is fitted into an internal "V" in the acrylic edge

unwoven at the ends, it was practically impossible to keep a few loose glass threads from floating out upon the clear portion of the specimen and being cured in place. To avoid the problem of these loose threads and also the undesirable handling of the wet laminae in the final preparation of specimens, laminates were cured into flat sheets in the manner described in the following paragraphs.

Each piece of fabric (about 23 in. square) was dipped into a pan of the prepared resin and laid in place on a 2-foot square piece of cellophane-covered tempered glass plate. As each piece was stacked on the glass plate, the trapped air bubbles were worked out with a suitable squeegee. When all layers were in place, Micarta strips $^1/_2$ in. wide and of proper thickness, were nested around all four edges to serve as spacers and also to prevent too much resin from escaping. A second 2-foot square piece of cellophane-covered tempered glass plate was then placed over the stack of impregnated fabric and clamped in place with a number of standard "C" clamps. After curing, the laminate was machined into strips for bonding to the acrylic specimen edges.

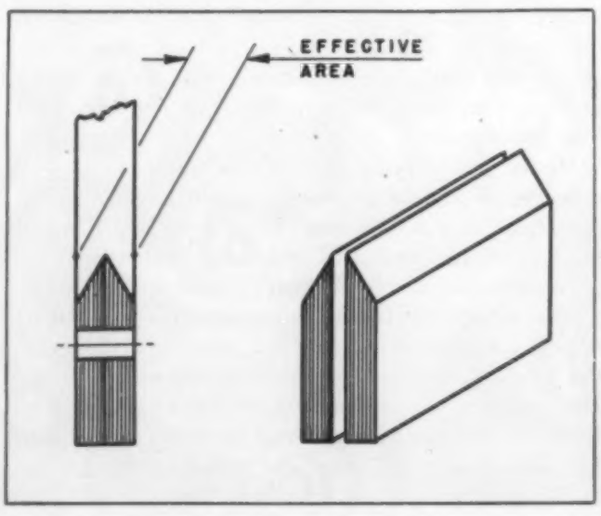
These flat laminated sheets were produced in thicknesses equal to one-half that of the acrylic component in order to facilitate beveling of the edges of strips which were machined from the flat sheets. Figures 2 and 3 illustrate how the beveled strips were placed together to form a mating *V*. The successful rapid machining of these strips was accomplished by using cutting tools with cemented carbide tips. The prepared resin was placed on all mating surfaces and the strips were cured in place by exposing the assembly to sunlight.

Tests made on this type of attachment showed that it had a strength equivalent to that made with individual wet laminae but it, too, had some distinct disadvantages. First, due to the shrinkage problem, which is difficult to handle, and due to the fact that resin cast in this manner has a lower strength than the original acrylic sheet, the scarf of the edge strips had to be of a length which would allow a transition gradual enough to produce an edge attachment possessing optimum strength.

The length of scarf that was necessary caused the opaque laminated edge to extend about $^1/_2$ in. above the usual canopy mount, thus decreasing visibility. Second, any excess resin which was present tended to be forced over the clear adjacent surface. This necessitated laborious polishing to restore the original optical qualities of the canopy.

Type II—internal V joint—This type of joint was also made by bonding the cured laminated strips to the

6—Advantages of internal "V" joint can be seen here. It is stronger, opaque edge can be kept flush with canopy mount and excess resin flows over laminate, not acrylic



prepared acrylic edge, but in this case the scarfed edges of the laminate were fitted into an internal *V* in the acrylic edge (Fig. 5). Tests made on this type of specimen showed that it was stronger than an equivalent external type of joint; and that an internal *V* 1/4 in. deep was as strong as any 3/4-in. external *V* joint. In addition, the disadvantages of the external type of joint were eliminated, because it was now possible to keep the opaque edge flush with the canopy mount and any excess resin present when the edge strips were bonded in place was forced over the opaque laminate instead of the clear adjacent acrylic sheet.

Figures 1 and 6 illustrate both types of joints and clearly indicate the advantages of the internal type of edge attachment.

Results of tests

a. *Tension tests*—As a result of stress concentrations, the efficiency of edge attachments in direct tension vary from 30 percent (for bolted attachments using rubber grommets and steel liners) to approximately 85 percent for laminated edge attachments. In terms of average stress at failure, the conventional bolted attachment developed approximately 2500 p.s.i. and the laminated edge attachments ranged as high as 6500 p.s.i.

b. *Bearing tests*—Since the specimens containing the laminated Fiberglas edges were failing outside of the actual joint and causing no appreciable elongation of the attachment holes, it was decided that a laminate containing all laminae of glass fabric was too strong. It was hoped that a laminate of cotton or linen cloth would solve the problem. However, the linen and cotton cloth-filled laminates failed in tension before there was any evidence of bearing failure. A number of laminated bearing specimens were fabricated using a combination of cotton cloth and glass fiber cloth. Elongation of the attaching holes was thereby controlled by the substitution of cotton cloth for certain glass fabric laminae.

c. *Fatigue tests*—Test specimens of the conventional rubber grommet and liner type and those containing the internal *V* type laminated edges were made identical to those used for tension tests. These were tested dynamically at various loadings and frequencies until failure occurred. The fatigue life of the laminated attachment was found to be over 1000 times that of the bolted type.

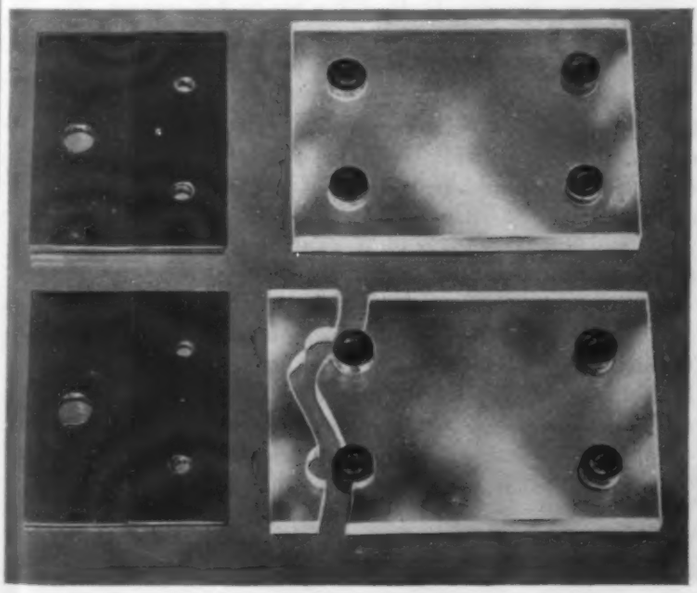
Applications of laminated edge attachment

a. *Aircraft canopies*—From the promising results obtained from the small test specimens, it was decided to prepare a full-size canopy of the type used on the P-80 airplane with the new type of laminated edge attachment and exhaustively tested under simulated flight conditions.

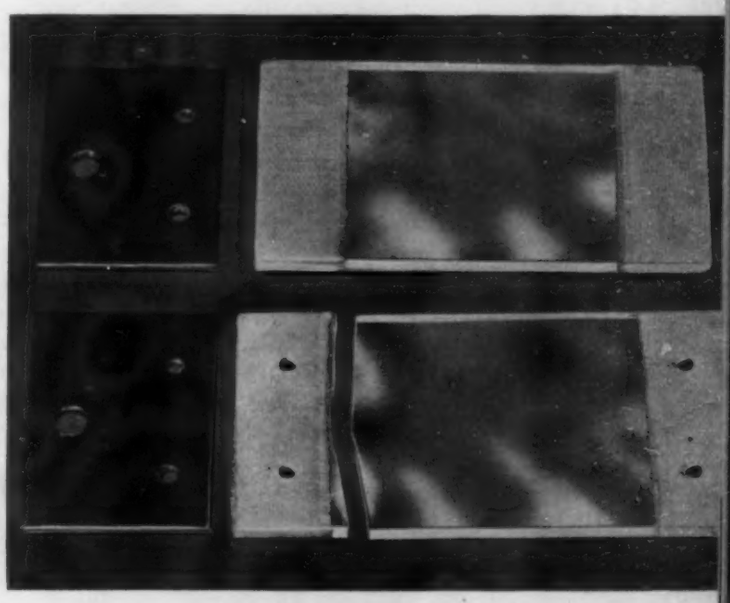
The P-80 canopy is of the one-piece Bubble type, which lends itself to free-blowing or vacuum forming. In this process of forming, a heat-softened acrylic sheet is clamped to a vacuum pot and free-drawn to a controlled depth. The shape of the vacuum pot opening gives the general outline required for the canopy edge. After forming is completed the enclosure is finish trimmed for mounting.

The P-80 production canopy is fabricated from 3/8-in. thick acrylic sheet. However, the new canopy which was to contain the laminated edging, was formed from a 5/16-in. acrylic sheet. (*Please turn to next page*)

7—Conventional method of attaching acrylic parts calls for holes large enough for insertion of rubber grommets, steel liners. Lower picture shows fatigue test results



8—The fatigue life of this internal "V" joint with laminated edge attachment, shown before and after fatigue tests, was over 1000 times that of conventional joint type





9—Outboard cured laminates are forced into intimate contact with machined edges of canopy before finally clamping into place to outboard fixture strips for the cure

Following is a step-by-step description of the detailed operations required in the preparation of the laminated strips and their subsequent attachment to the canopy edges:

1. Preparation of laminates: As a result of the bearing tests made on various types of laminates, a combination muslin and glass fiber cloth laminate was chosen, which would show an incipient bearing failure in the attaching holes at a load slightly below the average breaking load of the acrylic specimens. This would allow a more uniform distribution of the loads.

The laminated edge strip material, which was considered as the optimum for this type of attachment, consisted of two layers of coarse woven muslin with a layer of ECC-11-148 Fiberglas cloth on each outer surface. These laminates were made in the same manner as previously described, and their nominal thickness was chosen as $^1/_{64}$ in. less than $^1/_2$ of the minimum thickness of the canopy edge in order to make it possible to produce a completed edge strip with surfaces flush with the canopy surfaces. The laminated panels were cut into strips $1^1/_8$ in. wide and then beveled on one edge to mate with the canopy edge and also on each end to mate with adjoining strips.

It has been found that the variation in thickness of commercial canopies was as much as 0.100 in. due to manufacturing tolerances. In addition, the thickness variation may further be increased by the canopy drawing or stretching operation. However, by placing a strip of wet uncured resin-impregnated fabric between two cured laminated strips, it was possible to compensate for any variation in the thickness that is normally found.

2. Preparation of canopy edges: The edges of the special blown acrylic canopy were first trimmed shorter than a conventional canopy to allow for the addition of the laminated edge. The edges then were machined to form an internal *V*, since the internal *V* joint had proved to be superior from the standpoint of strength and ease of fabrication. The internal *V* was machined quite readily by the use of a portable hand router and a special bit.

Transparent contoured fixture strips, which were necessary to hold the laminated edging to the canopy and at the same time permit light to reach the joint to effect curing, were obtained by sawing off the edges of scrap production canopies. These contoured strips were then clamped on either side of the canopy edges so that they extended approximately $1^1/_2$ in. beyond the machined edges of the canopy. They served their purpose effectively for the forming of the laminated strips and also as transparent fixtures for holding the formed laminated strips securely in position during the curing cycle.

3. Forming of laminated edge strips: The prepared laminated strips were formed to mate with the ever-changing contour of the canopy edges. Since the resin used to make the laminates was a thermoplastic, it was only necessary to heat the strips for several minutes in an oven at 300° F. and then hold them in place in the grooved canopy edges until they cooled. This was facilitated by the transparent fixtures (edges from scrap canopies) clamped to the prepared canopy edges. The hot, pliable laminated strips were forced down onto the machined edges of the canopy and clamped to the overhanging transparent fixture strips until they had cooled enough so as to retain their new contour.

4. Curing of preformed laminates to canopy: The next step in the fabrication of the edge attachment was to sandwich a wet resin impregnated glass fiber lamina between two cured, formed laminated strips to build up the thickness of these edge strips to equal that of the canopy edge. Excess resin from the wet laminae flowed into any spaces created by the varying edge thickness of the canopy and was thus cast and cured into place around the canopy edges to form a smooth, clear and continuous transition from the opaque

laminated edge to the transparent methyl methacrylate canopy material.

To simplify tooling, the attaching operation was accomplished in two steps. In the first step, the cellophane-covered transparent fixture strips were clamped only to the inside edges of the canopy. The chamfered edges of the inboard cured laminated strips were *doped* with resin, forced into contact with the canopy edges and clamped in position to the fixture strips for curing. The second curing step was taken after removal of the inboard transparent fixture strips. The wet impregnated glass fabric lamina was then placed on the previously attached inboard laminated strip. Next, the chamfered edges of the outboard cured laminates were doped with resin and carefully placed in their correct position on top of the wet lamina. The cellophane covered outboard transparent fixture strips were then placed on top of this assembly and clamped in place to the canopy. As a final operation to assure correct positioning, the outboard cured laminates were forced into intimate contact with the machined edges of the canopy before finally being clamped in place to the outboard fixture strips for curing. The setup is clearly shown in Fig. 9.

The canopy (Fig. 9) with the laminated edging was subjected to pressurization tests along with production canopies containing the rubber grommet and metal liner type of attachment. The laminated edge type of canopy, blown from $^5/_{16}$-in. thick acrylic material, withstood pressurization loads 25 percent greater than those which produced failure in the $^3/_8$-in. thick production canopies. This $^5/_{16}$-in. thick canopy containing the laminated edging was not tested to distruction but was saved for possible investigation of other variables. The canopy shown in Fig. 9 was actually one of three which were fabricated with the laminated edging for testing purposes.

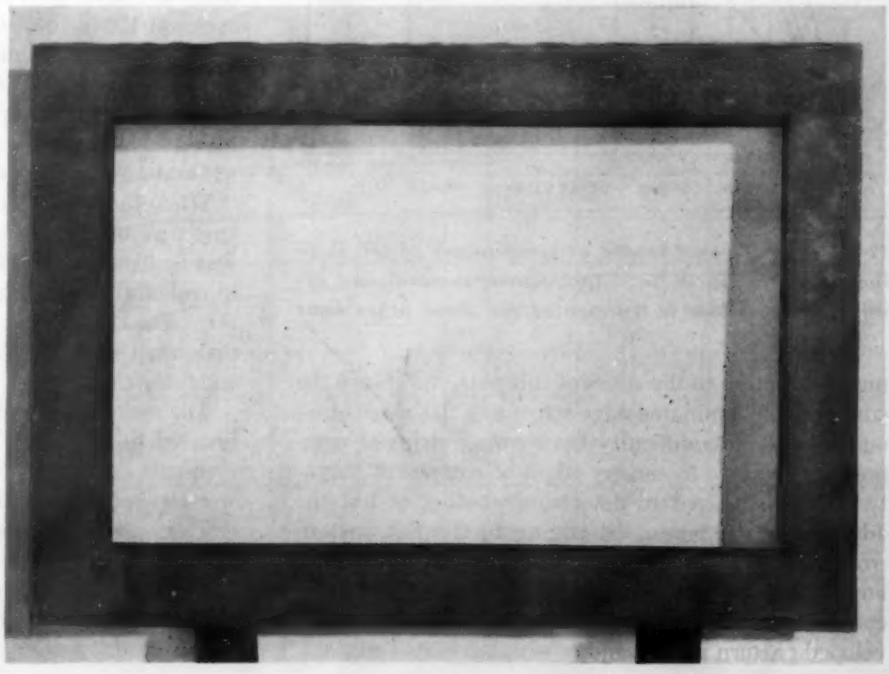
The first one, formed from $^5/_{16}$-in. thick acrylic sheeting, failed prematurely at a load higher than that withstood by any previous production canopy, when part of the mounting structure failed. After reinforcement of the mounting structure, the second $^5/_{16}$-in. thick canopy was tested as previously described and then saved for possible future investigations.

The last and third canopy was formed from $^1/_4$-in. thick acrylic sheeting. Considerable speculation has awaited the test results of this particular canopy. Unfortunately, however, it was cracked during installation. Consequently, further testing was, of necessity, discontinued.

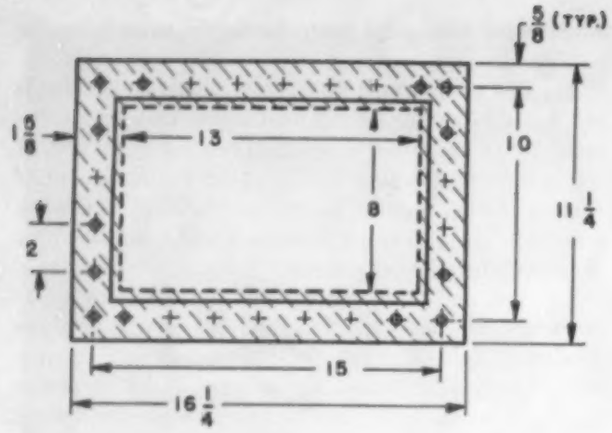
5. Fabrication of canopy from a flat developed pattern: Near the end of the war an ingenious method was developed by a West Coast plastics fabricator[2] for the free-blowing of aircraft canopies from a flat developed pattern. Tbis method consisted of machining a sheet of acrylic to the exact flat developed pattern of the canopy. After heating the flat blank in a specially constructed oven, it was carefully laid on a blowing jig and securely clamped around all edges to effect a perfect seal against air leaks before the blowing operation was started. Positive air pressure was used rather than pulling a vacuum. This enabled the operator to check the part during the blowing process and control the air pressure throughout the operation.

The canopy for North American's P-51 Mustang fighter plane was free-blown from a flat developed pattern using this method. With North American's permission a P-51 canopy was secured by Lockheed in the flat pattern, and Lockheed's laminated edge attach-

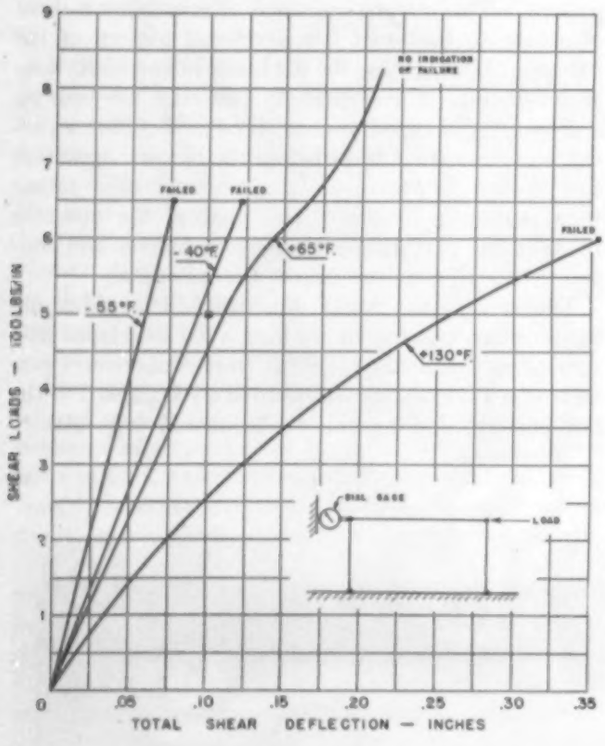
[2] Stacks Plastics.



10—*Acrylic panel with laminated glass cloth edging to be tested. Shear loads will be applied to the panel frame by means of hydraulic jacks*



11—*Diagram of acrylic panel with laminated edging prior to testing. It will be mounted in steel shear frame with pin-connected corners and attached to rigid structure*



12—*Results of panel loaded at temperature of 65° F. in increments of 50 lb./in. Application, removal and reversal of shear load is represented for three other tests*

ment was cured to the edges of this pattern. Since the curing of the laminated edge strips to a flat sheet obviously entails less difficulty than curing strips of compound curvature to canopy edges of compound curvature, it was desired to determine whether or not the addition of the laminated edging to the flat pattern would alter the forming characteristics of this particular free blowing method. No difficulties were encountered in the final operation of blowing this flat developed pattern into a canopy with laminated edges.

The hand methods used in fabricating the special laminates and their subsequent attachment to the canopy edges were necessarily laborious. However, when production methods are considered, it is apparent that certain operations could be eliminated or greatly simplified. The method of blowing canopies from a flat developed pattern would further facilitate production if it were applied to the laminated edge-type of methyl methacrylate canopy.

b. *Stressed acrylic panels*—Since joints of 85 percent efficiency were consistently being produced of laminated strips to acrylic sheeting and were developing stresses as high as 6500 p.s.i., the possibility of using stressed methyl methacrylate panels was given very serious consideration.

One of the characteristics desired to be known about an acrylic panel which incorporated a laminated edge attachment, was its behavior when subjected to shear loads that were made at both normal and extreme temperature ranges.

1. Shear tests: The method used in fabricating the shear test specimens was essentially the same as that used for fabricating the canopy laminated edge attachment. Three test specimens were made from $^{3}/_{8}$-in. thick acrylic sheeting (Figs. 10 and 11). These panels were mounted in a steel shear frame having pin-connected corners, and the assembly was attached to a rigid floor structure. The shear loads were applied to the panel frame by means of hydraulic jacks and transferred to the plastic panel through the $^{1}/_{4}$-in. diameter attaching bolts. Total shear deflections were measured by means of a dial gage. A temperature controlled enclosure was constructed all around the test panel just described so that various temperatures could be accurately maintained.

The first panel was loaded at a temperature of 65° F. in increments of 50 lb./in. (Fig. 12). The application, removal and reversal of shear load was repeated for 1000 cycles at 150 lb./in., 1000 cycles at 300 lb./in. and 3000 cycles at 500 lb./inch. This repetition of loading showed no change in the shear deflection noted at the beginning of each cycling test. A maximum static load of 850 lb./in. was applied at room temperature without any serious permanent effects.

When the above tests were completed, the temperature was lowered to −55° F. and a load of 300 lb./in. was applied and maintained for two hours. Upon removal of all load there was no indication of permanent set. The load was then gradually increased to a maximum value of 650 lb./in., whereupon the specimen suddenly shattered.

The second panel was installed and the temperature lowered to −40° F. Loading was applied in small increments, and again when the value of 650 lb./in. was reached, the panel suddenly shattered.

The third and last panel was tested at 130° F. Loading was applied in 50 lb./in. increments until a load of 600 lb./in. was attained. Failure occurred approximately 90 sec. after application of the 600-lb./in. load.

The amount of deflection at various temperatures is compared below:

Temp. ° F.	*Shear load, Lb./in.*	*Total deflection, in.*
−40	650	0.120
70	650	0.155
130	600	0.354

2. Tension creep tests: The purpose of these tests was to determine the behavior of an acrylic panel incorporating laminated glass fabric edges under prolonged tensile loading at various temperatures. Test specimens were made from $^3/_8$-in. thick sheet stock with the glass fabric edge attachment at each end (Fig. 13).

Specimens were suspended in a controlled temperature enclosure by means of a double shear type of fitting. At the lower end, arrangement was made for applying 2400 lb. (600 lb./in.) through a single shear type of fitting, so that there was an eccentricity of $^9/_{32}$ in. between the suspension and the applied load. Two dial gages, calibrated in thousandths of an inch, were installed, one on either side of the specimen, to indicate the total elongation in the 10-in. gage length. Time vs. elongation curves for different temperatures are presented in Fig. 14.

The tests indicated that when the load was first applied, the rate of creep was high, but that it decreased rapidly over the first several hours.

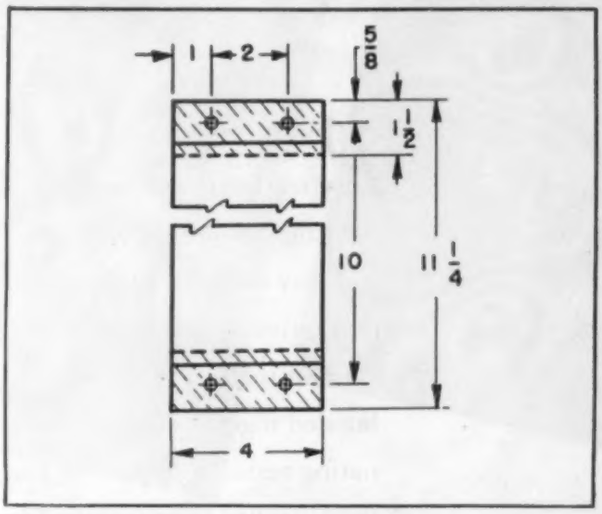
Creep effect is greatly influenced by temperature, as may be seen by referring to Fig. 14. Considering 10 hr. as a reasonable period for *long-duration* loading, it is apparent that under 600 lb./in. load and at room temperature, the observed creep constituted only an additional 12 percent above the elastic (instantaneous) elongation, while at 140° the deformation would almost double itself. Under this load and at any temperature up to 140°, 10 hr. appears to be sufficient time for a reasonable stabilization of the elongation.

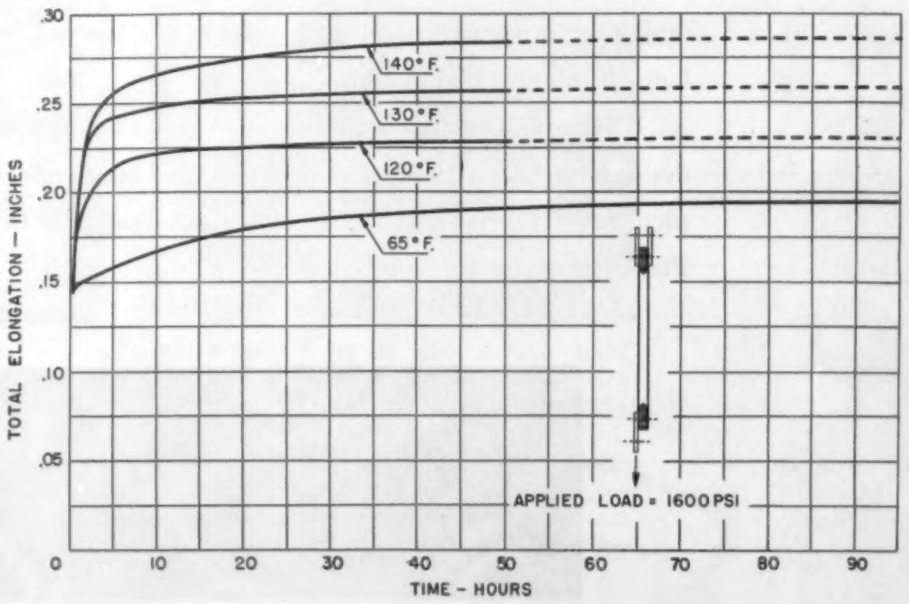
At the conclusion of the tests, no permanent elongation of the holes in the Fiberglas reinforced edge was apparent. It is improbable that any appreciable amount of the observed creep effect occurred in the laminated edges.

Summary

In summarizing, it is pointed out that a laminated edging integrally attached to acrylic sheeting consistently approached and, in certain cases, developed the full strength of the cast acrylic sheeting. Where further reduction in load concentrations is necessary at attachment points, various combinations of filler material may be used in the laminated edging to produce controlled bearing failure in the attaching holes.

13—Behavior of acrylic panel, incorporating laminated glass fabric edges under prolonged tensile loading, tested using $^3/_8$-in. thick sheet stock with edge attachment





14—Time vs. elongation curves for different temperatures are presented in these tension creep test results. When load was first applied the creep was high but it decreased after first several hours

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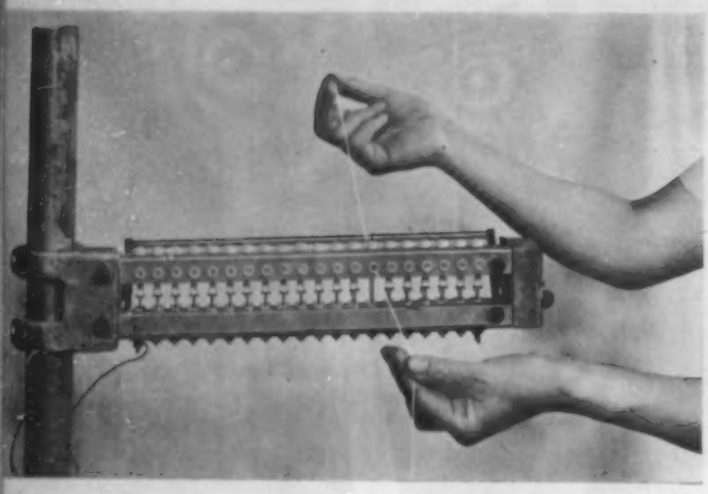


REDUCED BREAKAGE of syrup dispensers at soda fountains is an important factor in the selection of Cyanamid's MELMAC® plastic 3020 molding material by the Weber Showcase and Fixture Company for standard equipment. This impact-resistant material is also clean, tasteless, and highly resistant to staining. It is the first impact-resistant thermosetting plastic available in stable light colors. Molded by the Plastic and Die Cast Products Corporation.

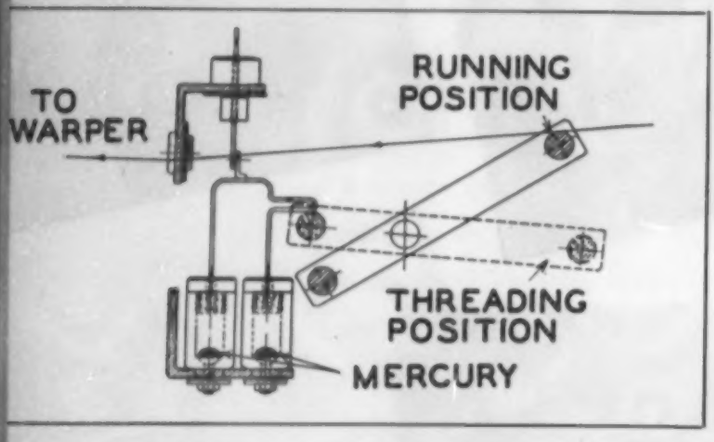


WATER ROLLS RIGHT OFF these wooden ducks' backs, too, without damage, since they're glued with Cyanamid's URAC® resin adhesive 185. The manufacturers, Wildfowlers Decoys of Saybrook, Connecticut, found that this low-pressure, craze-resistant resin adhesive forms a durable, water-resistant bond. URAC resin adhesive 185 is used to glue heads and keel-like bases to the hollow pine duck decoy bodies.

Molded part helps control yarn windup



1—A close-up of a creel arm shows the eyelets through which yarn is threaded. When the yarn breaks, the contact wires drop into two molded cellulose acetate mercury cups, thus stopping the action of the winding apparatus



2—This diagram explains position of the cellulose acetate mercury cups which have the advantage of transparency, resistance to breakage and good insulating qualities

ONE of the most important machines in use by the textile industry is the *creel*, consisting of a structural framework with provisions for mounting cones wound with yarn, tire cord, rayon thread, etc. And some of the most important elements in this machine are the cellulose acetate mercury cups that are vital to the operation of the mercury stop motion units. The creels are built in several types suitable for the work required. Some are mobile units, mounted on casters; other types are permanently installed. Approximately 10 sizes are available to accommodate from 200 to 1000 cones of yarn.

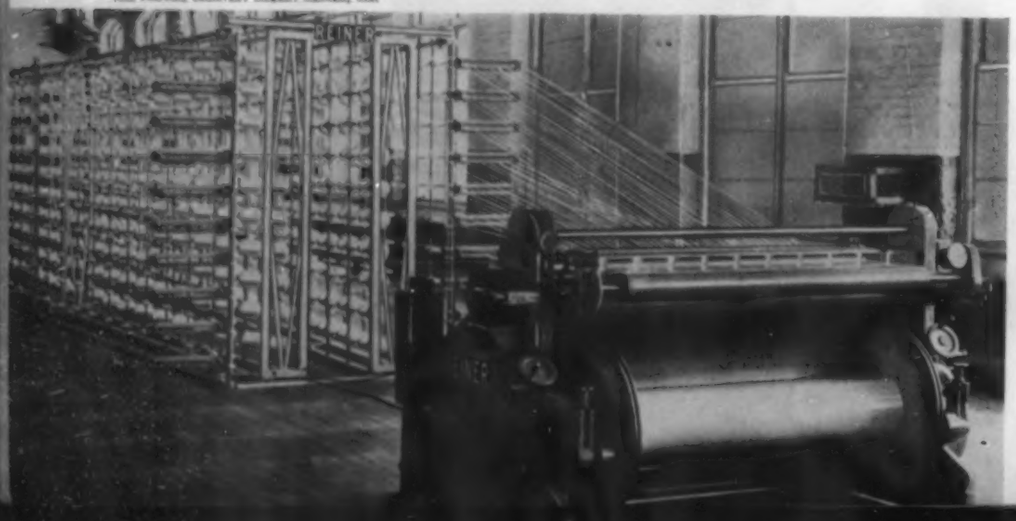
The creeling operation consists in winding the yarn from the individual cones onto a beam, or large spool $5^1/_2$ to 7 ft. long, which is mounted in a horizontal position and power driven. This rewinding, which condenses the yarn into a small volume, facilitates handling. The creeled yarn or thread is subsequently transported on the beam, set up, and unwound on any of the following subsequent operations: twisting, looming, knitting, warping, hoisery knitting, embroidery, tire cord weaving, rug weaving.

It will be noted in Fig. 3 that there are 10 projecting arms on both the right and left sides at the front of the machine. These are the mercury stop motion units (Figs. 1 and 2,) each of which has 20 eyelets. Through these eyelets is passed a single yarn or thread from an individual cone.

These eyelets control the running or stopping of the beam driving mechanism. If any individual yarn or thread breaks, the contact wires are dropped into the two mercury cups (Fig. 2), stopping the driving motor and applying a magnetic brake to the beam motion.

After considerable experimentation and the use of mechanical means to accomplish this effect, the engineers of Robert Reiner, Inc., in collaboration with engineers of the Boonton Molding Co., developed the transparent cellulose acetate mercury containers and covers to effect this sensitive control. The plastic parts have admirably met the exacting requirements of parent and electrical insulating structures, so necessary to the efficient operation of these machines.

ALL PHOTOS, COURTESY ROBERT REINER, INC.



3—Control over the running and stopping of the creel on which yarn is transferred from individual cones to a large spool is function of the 10 mercury stop-motion units mounted on both sides of creel



TWO-COLOR MOLDING Produces New Tenite Keys

Tenite adding-machine keys double-injection molded by Electric Manufacturing Co. for Clary Multiplier Corp.

Keys of this adding machine are double-injection molded. Tenite of one color is injected to form numerals and letters; after that has hardened, a second color is injected for the body of the key. Molded-in numerals and letters are thus as permanent as the color, which is inherent in Tenite and cannot wear off. Under constant hard use, Tenite keys remain lustrous, new-looking, and easy to read.

The excellent molding properties of Tenite which adapt it to this process also make it one of the most widely used materials for injection molding and continuous extrusion. Tenite is formed into products of many sizes and shapes at the fastest speeds possible with plastics. It comes from molds and extrusion machines with a high natural luster which requires no polishing and a minimum of finishing.

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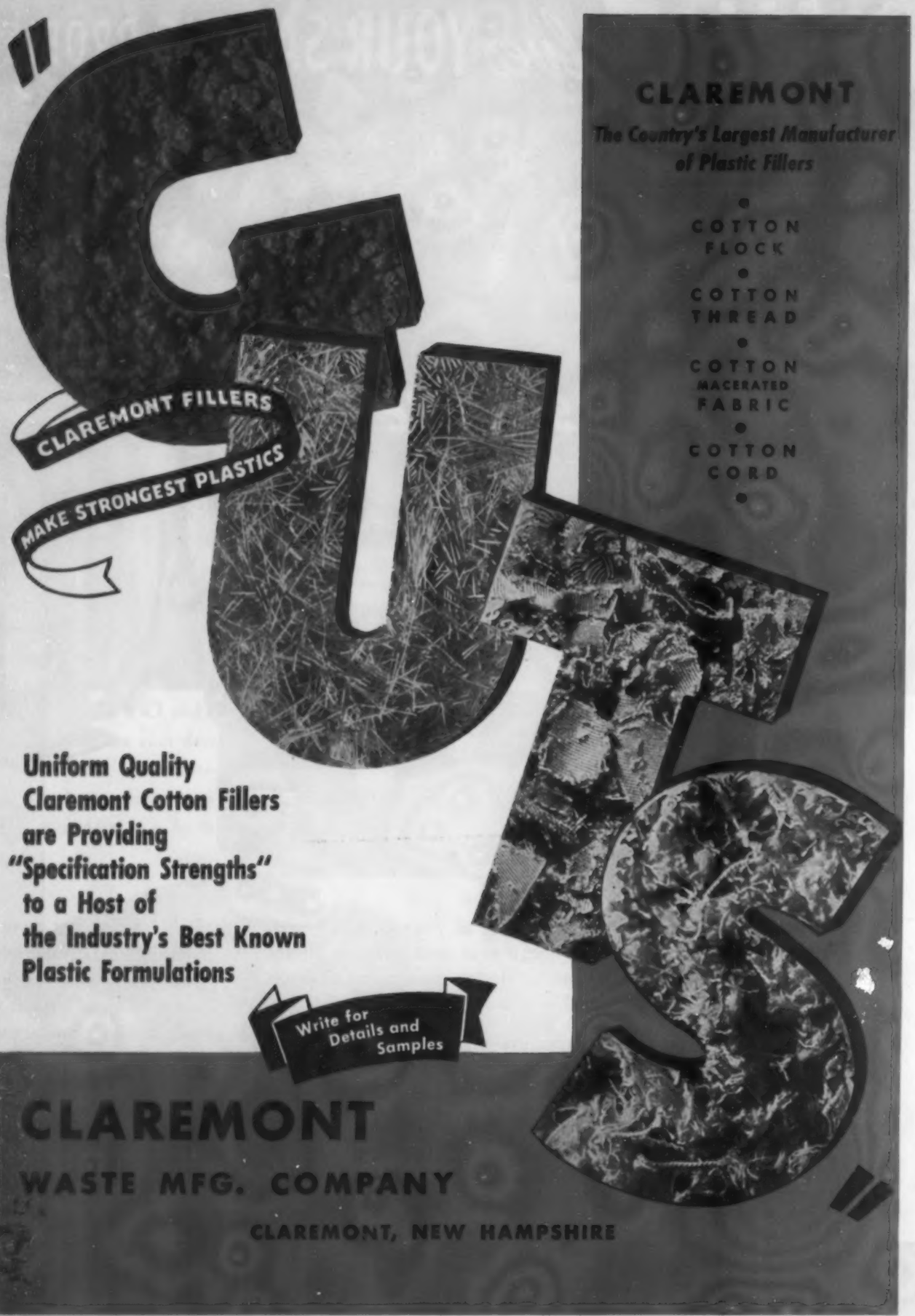
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Non-woven cotton webs in laminates*

by SIMON WILLIAMS†, E. V. PAINTER‡ and CARL M. FERGASON§

THIS report summarizes the results of an investigation, initiated in January 1944, relative to the use of non-woven webs of cotton fibers in plastic laminates. At the time the research was started, the search for lightweight, high strength materials for strategic war uses was at its peak and had projected the use of plastic laminates containing fabric fillers into a position of importance without precedent. During this period, a new type of laminate was pioneered by the Hood Rubber Co. in which non-woven webs of cotton fibers were substituted for the conventional fabric filler, with results that were extremely significant in terms of improved physical properties and potential economies in manufacture. A review of the status of the urgency of the problem and the state

* A contribution of the Research Division, National Cotton Council of America, in affiliation with the Bureau of Industrial Chemistry, University of Texas.
† Fabric Research Laboratories.
‡ Senior research associate, Fabric Research Laboratories, Inc.
§ Cal-a-Por, Inc.

SUMMARY

Experiments were conducted relating to the use of non-woven webs of cotton fibers in plastic laminates under the sponsorship of the Office of Production Research and Development, Industrial and Consumer Products Branch, War Production Board.

Over the range of fiber lengths studied (1/2 to 1 9/16 in.) the tensile strength of web-base laminates tended to increase with increasing fiber length. The effect of increasing the degree of fiber orientation in the web by drawing was to increase laminate tensile strength.

Except for the case of the 1/2-in. staple, which yielded low values, flexural strength was not significantly affected by either staple length or orientation variations.

Moisture absorption, impact strength and electrical properties were more strongly influenced by the resin used than by any properties of the web filler.

When the webs were *not* cross-plied, the influence of fiber orientation was marked, resulting in a laminate of very high tensile strength in the direction of increasing fiber orientation (with grain) and very low strength at right angles to this direction (cross-grain).

When the webs *were* cross-plied, the influence of the orientation of the fibers was negligible, irrespective of the direction of applied force.

Some evidence was developed which indicated that the lighter the web, for a given number of plies, the stronger the laminate.

Staple length and orientation had little influence on moisture absorption and dimensional stability. However, all of the web-base laminates exhibited a high degree of dimensional stability under excessively high water absorption.

All of the web-base laminates gave impact strengths equal to or better than those encountered in the usual fabric-base laminate. The values obtained depended upon the resin used. One resin (BV-16526) gave unusually high impact values, but the tensile strength was slightly less and water absorption considerably higher than with another resin (BV-1112) which gave ordinary impact strengths, fairly high tensile strength and a normal, low water absorption.

The effects of press temperature, pressure, time of pressing, and resin pick-up were investigated for several resins.

of the art, and subsequent discussions with several war agencies, led to the conviction that it was highly desirable to investigate certain factors affecting the quality of these web-reinforced laminates. Hence, this project was initiated in cooperation with the Hood Rubber Co. and under O.P.R.D. sponsorship.

The primary objective of the project was the determination of those characteristics of the fiber filler exerting the greatest influence on the properties of the final laminate. Thus, such properties as staple length, fiber orientation, grade of cotton and other characteristics of the fiber were to be of immediate concern, and studies relating to different resin types, processing variables or other development type work were to be included only as the logic of the experimental procedure dictated. The process development phase of the study was not included in the original concept of the project.

As of June 30, 1945, work on this project was terminated. The course of the war was such that materials of the type being investigated could no longer be considered of great strategic importance and, in light of these circumstances, it was considered advisable to terminate the research. Therefore, much of what is reported is incomplete.

Processing method

The production of a web of cotton fibers, the impregnation, the drying and curing, and the pressing into a finished laminate were all carried out on a small pilot plant scale. Standard machines and practices used in the textile and laminating industries were used as much as possible. The principal differences were in the addition of a modified draw frame as a means of orienting the fibers and in the modification of conveying mechanisms to make it possible to handle the fragile webs.

The web itself was produced by a miniature Davis and Furber roller card, which makes a web about 10 in. wide. This machine is shown in Fig. 1. In order to secure a web of uniform weight a controlled feed was arranged by placing segments of card sliver (from a standard cotton card) at regular intervals on the feed apron (seen at left center of Fig. 1). A web of the desired weight per foot was obtained by accumulating enough layers (usually 10) on the endless duck belt seen at the right in Fig. 1. The finished web was removed from the endless belt and rolled between layers of packing paper, the ends being spliced to secure long continuous lengths for drawing and impregnating. This whole procedure of web production was adopted as a convenience for small-scale purposes; industrial practice of web production commonly employs a number of cards, depending on the weight of web desired, mounted over a conveyor belt and the web is accumulated continuously.

The operations of drafting the web to produce fiber orientation, impregnating with resin, drying and curing were performed continuously. Figure 2 shows the drawn web as it passed from left to right down through the resin bath maintained between a pair of horizontal steel rolls and subsequently through a vertical pair of steel squeeze rolls, the tightness of which regulated the amount of resin picked up by the web. The wet, impregnated web passed into the drying and curing tunnel at the right of Fig. 3. The cured web was wound at the other end of the tunnel on a squirrel cage drum. The web was then readily cut from the drum, cut in squares, and properly stacked for loading in the hydraulic molding press, where it was pressed in the conventional manner to produce the finished sheet of laminate. The first operation of drafting was merely by-passed in producing laminates from *undrawn* webs. In the case of *twice-drawn* webs, the once-drawn web was accumulated exactly as the undrawn web was obtained at the roller card and passed through the drawing rolls a second time.

Testing methods

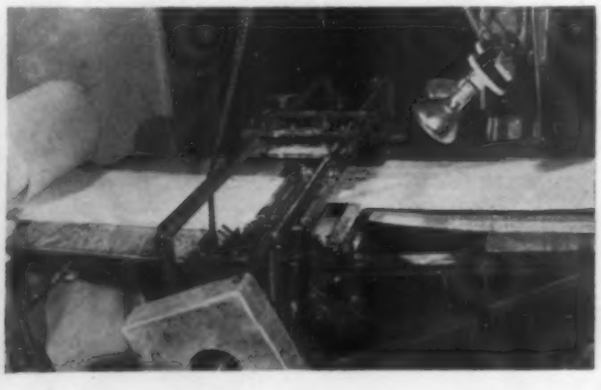
Tensile strength data were obtained with a modified horizontal Scott tester and a Dillon tester, as noted in the tables. In using the Dillon tester, A.S.T.M. D 638–42 T was followed. The capacity of the Scott tester (used during the early stages of the work) was such that samples thinner than $^1/_8$ in. were used and the A.S.T.M. specifications could not be followed in regard

1—*A model woolen card used in preparing webs for subsequent drawing and impregnation*

PHOTO, COURTESY R. ROBINSON



2—*Modified drawing frame for drafting webs to increase the parallelization*



to sample thickness. However, some data are shown indicating the effects of different specimen thickness on tensile strength which point to the validity of the procedure followed during several phases of this study (Table III). Furthermore, the Scott was checked against a Baldwin-Southwark universal tester and no significant differences in strength data were noted in any given case.

Elongation was measured with a dial-type extensometer mounted on the center 2 in. of the specimen.

Bonding strength was measured using a 10-mm. diameter steel ball pressed into the small edge of a 1 by 1 by $^1/_2$-in. specimen, with a rate of loading of 1000 lb. per minute. The effect of loading rate was studied from 500 to 4000 lb. per min., with no significant differences in bonding strength noted.

Izod impact strength[1] was determined on a standard Baldwin-Southwark Izod impact testing machine, according to A.S.T.M. D 256–43 T, using a 16-lb. weight on all flatwise samples and an 8-lb. weight on all edgewise samples.

Flexural strength[1] was determined according to A.S.T.M. D 560–42T, except that the span-depth ratio was 16 to 1.

Moisture absorption and *dimensional stability* were tested according to Navy Specification JAN-P-13, paragraph F-6c(1).

Density was calculated from the weight and dimensions of the material just prior to running moisture absorption tests.

Dielectric strength[2] was measured perpendicular to the lamination in accordance with A.S.T.M. D 149–40 short time test. All tests parallel to lamination were made according to Navy Specification JAN-P-13.

Power factor and *dielectric constant* were measured at frequencies of 1 kilocycle and 1 megacycles. Navy Specification JAN-P-13 was used as a reference. However, because of equipment difficulties, some modifications in technique were employed. JAN-P-13 requires that the bridge that is used be suitable for use at frequencies up to 30 megacycles. The bridges actually used were not suitable for high frequencies, but were designed for use at the frequencies actually tested. Thus at 1 mc., the bridge used was a General Radio Co. radio frequency bridge, type 516-C; at 1 kc., a General Radio Co. capacitance bridge, type 716-A, was used. The test methods conformed to the applications of these bridges by the General Radio Co. Furthermore, since neither bridge could be used with a guard ring, the samples tested were cut in a 4-in. square, one side completely covered with foil, while a 3-in. diameter foil disk was centered on the other side, permitting an edge-effect correction to be calculated according to National Bureau of Standards Research Paper RP-1217, June 1939.

Effect of specimen width and thickness

Table III indicates the effect of specimen thickness and width on tensile strength obtained on the Scott tester. The strength shown was based on the original cross section of the test specimen and seemed to indicate that for the laminates containing BV resin types, no significant change in tensile strength was to be anticipated when 20 or more plies of web of the weight studied were used. The assumption was made, therefore, that the data shown in Tables II, V and VI, which were collected from sheets containing 30 plies of web similar to that used in preparing Table III, were comparable to the remaining data reported, developed through the testing of standard A.S.T.M. specimens on a Dillon Model K tester. (*Please turn to next page*)

[1] These tests were made in the N.E.M.A. laboratories at Johns Hopkins University through the cooperation of Professor R. K. Witt.
[2] Made by Formica Insulation Co. through courtesy of Mr. J. C. Pitzer.



3—*Resin impregnator and the head end of the drier*

Table I.—Effect of Laminating Pressure on Physical and Electrical Properties of Cotton Web-Based Laminates Made with Resin BV-16526

Staple length,[a] *in.*	$1^1/_8$	$1^1/_8$
Type web[b]	*Once drawn*	*Once drawn*
Laminating pressure,[c] *p.s.i.*	*1000*	*250*
Resin add-on, percent	67	74
Volatiles, percent	8.3	8.3
Density	1.31	1.08
Water absorption, percent	9.0	11.4
Thickness change,[d] percent	−0.8	−1.4
Tensile strength[e]		
With-grain, p.s.i.	19,800	18,750
45° to grain, p.s.i.	....	16,063
Elongation at break		
With-grain, percent	....	2.8
45° to grain, percent	....	4.9
Flexural strength, p.s.i.	24,740	22,270
Modulus of elasticity in flexure, p.s.i.	1,209,500	1,107,500
Izod impact strength[f]		
Flatwise, ft. lb./in. notch	22.13	13.66
Edgewise, ft. lb./in. notch	3.72	3.61
Bonding strength, p.s.i.	680	1,460
Dielectric strength		
Parallel to laminations, kv.	13.6	13.5
Perpendicular to laminations, v./mil	115	114

[a] Mean length of the fibers in the upper half, by weight, of the sample, obtained from a Suter-Webb array by A.S.T.M. D 414–46T.
[b] Original weight of card web to be drawn: 0.95 to 1.08 grains per sq. inch. Subjected to draft of 6.03. Cross-plied 3 by 3 layers.
[c] All samples pressed at 310° F. for approximately 1 min. for each 0.01 in. thickness.
[d] Changes in width and length too small to measure with available equipment.
[e] Tested on a Dillon Model K. With-grain samples cut parallel to any edge of sheet.
[f] Correction for friction and windage applied in all cases.

Table II.—Some Effects of Processing Variables on Tensile Strength and Elongation[a]

Resin	Press-sure	Press time	Press tem-pera-ture	Resin pick-up	Low-pressure cycle		With-grain			Across-grain		
					Press-sure	Time	Tensile strength Average	S.E.	Elon-gation at break	Tensile strength Average	S.E.	Elonga-tion at break
	p.s.i.	min.	° F.	%	p.s.i.	min.	p.s.i.	p.s.i.	%	p.s.i.	p.s.i.	%
Bakelite BV-16526	100	3	275	242			16,400	2600	2.7	3670	130	1.7
	100	3	310	242			22,400	900	2.1	3400	60	1.0
	100	3	345	242			25,200	1000	2.6	5200	220	1.2
	100	6	275	242			20,100	1000	3.0	4860	150	2.1
	100	6	310	242			23,100	1000	1.2	6200	700	0.9
	100	6	345	242			24,000	1000	2.1	5200	100	1.3
	100	12	275	242			19,700	1600	2.2	4900	470	2.4
	100	12	310	242			24,180	1100	1.4	4600	600	0.5
	100	12	345	242			17,300	2200	1.7	4550	520	1.1
	100	24	275	242			21,800	2300	2.0	3430	250	1.1
	100	24	310	242			20,300	1100	1.6	5680	190	1.1
	100	24	345	242			23,800	1800	1.8	5370	230	1.1
	250	3	275	242			16,800	3600	2.2	4860	70	3.7
	250	3	310	242			24,900	4000	1.3	5000	200	0.7
	250	3	345	242			22,000	3300	1.8	4620	480	1.0
	250	6	275	242			23,800	1400	3.0	4780	140	4.6
	250	6	310	242			24,000	1300	1.3	5100	220	0.7
	250	6	345	242			26,300	600	2.8	5060	100	2.5
	250	12	275	242			23,300	1800	3.0	4780	140	4.3
	250	12	310	242			19,700	3200	0.6	3800	150	0.9
	250	12	345	242			23,800	1500	2.2	5360	110	1.4
	250	24	275	242			21,000	3000	2.6	4460	45	4.7
	250	24	310	242			26,900	500	2.8	5100	100	2.3
	250	24	345	242			23,500	3500	2.8	5140	350	3.3
	500	3	275	242			22,700	1500	2.4	3800	80	2.8
	500	3	310	242			....	..	...	..	...	...
	500	3	345	242			21,700	1000	2.2	5600	200	2.0
	500	6	275	242			27,100	1300	3.0	4580	270	4.2
	500	6	310	242			24,800	800	2.6	3600	100	1.0
	500	6	345	242			24,000	800	2.9	5260	400	3.5
	500	12	275	242			26,800	1000	2.7	4730	50	3.8
	500	12	310	242			26,600	1000	2.9	4800	110	3.7
	500	12	345	242			25,400	1000	2.6	4550	190	4.5
	500	24	275	242			25,300	1000	2.8	4800	70	4.2
	500	24	310	242			29,900	700	3.6	5340	570	5.8
	500	24	345	242			23,000	500	2.2	4500	630	2.7
	1000	3	275	242			26,200	1100	1.8	4700	150	3.2
	1000	3	310	242			14,100	800	1.1	4800	180	1.9
	1000	3	345	242			23,400	500	2.3	4000	220	2.5
	1000	6	275	242			28,900	1100	3.1	6090	270	4.0
	1000	6	310	242			27,700	1500	3.1	5700	1300	3.8
	1000	6	345	242			27,100	1100	2.6	4660	340	2.7
	1000	12	275	242			26,100	1100	2.4	4700	150	1.6
	1000	12	310	242			27,400	1000	3.3	5100	230	4.2
	1000	12	345	242			21,300	1100	3.1	5900	100	2.4
	1000	24	275	242			26,700	1600	2.7	5580	100	2.1
	1000	24	310	242			26,100	1000	3.8	5400	125	3.6
	1000	24	345	242			21,800	120	2.5	5000	80	2.0
	250	6	305	27	50	2.5	5,400	100	2.5			
	250	6	305	61	50	2.5	17,500	400	2.3			
	250	6	305	70	50	2.5	20,800	300	2.9			
	250	6	305	75	50	2.5	22,800	500	1.7			
	250	6	305	157	50	2.5	27,000	900	2.2			
	250	6	305	205	50	2.5	24,000	400	2.1			
	250	6	305	221	50	2.5	24,500	2200	2.8			
	250	6	305	295	50	2.5	28,800	1000	2.6			
	250	6	305	316	50	2.5	21,600	400	2.4			
	250	6	305	535	50	2.5	14,700	800	1.3			

Table II. (*Continued*)—**Some Effects of Processing Variables on Tensile Strength and Elongation**[a]

Resin	*Press-sure*	*Press time*	*Press tem-pera-ture*	*Resin pick-up*	*Low-pressure cycle*		*With-Grain*			*Across-Grain*		
					Press-sure	*Time*	*Tensile strength Average*	*S.E.*	*Elon-gation at break*	*Tensile strength Average*	*S.E.*	*Elonga-tion at break*
	p.s.i.	*min.*	*° F.*	*%*	*p.s.i.*	*min.*	*p.s.i.*	*p.s.i.*	*%*	*p.s.i.*	*p.s.i.*	*%*
Melmac 402	250	5	280	150			25,000	3000	2.0	4350	300	1.2
	500	5	280	150			27,900	400	1.9	5350	350	1.4
	1000	5	280	150			30,900	1050	1.9	3850	230	1.3
	1000	5	250	150			32,300	1500	2.0	5650	160	1.1
	1000	5	280	150			30,900	1050	1.9	3850	230	1.3
	1000	5	310	150			23,800	2200	1.7	5000	180	1.1
	1000	2	280	150			30,000	2080	1.8			
	1000	4	280	150			27,900	300	1.9			
	1000	5	280	150			30,900	1050	1.9			
	1000	10	280	150			25,900	4000	1.8			
Bakelite BV-17018	250	6	275	310			12,700	800	1.4	3200	500	0.6
	250	6	300	310			13,000	600	2.0	2800	100	1.6
	250	6	310	310			12,400	600	1.9	2800	100	1.4
	250	6	325	310			11,000	600	1.8	2400	100	0.6
	100	6	310	310			11,000	600	2.3	2400	100	0.2
	250	6	310	310			12,400	600	1.9	2800	100	0.9
	500	6	310	310			11,200	600	2.0	2400	100	0.7
	1000	6	310	310			12,600	600	1.7	3000	500	0.5
	250	6	310	125			20,400	1400	1.6	3400	500	1.6
	250	6	310	225			17,000	600	2.0	3000	100	0.3
	250	6	310	311			12,400	600	1.9	2800	100	0.9

[a] All results are the average of five breaks made on Scott tester. Average values shown, with standard error (S.E.).
All samples prepared with all plies parallel (no cross lamination).
All cotton webs drawn once prior to impregnation.
All webs weighed 115 grains/foot 10 in. wide before drafting, 6.03 draft on drawing frame.
All samples with 30 plies—approximately 0.030 in. total thickness.
Cotton used—middling Bobshaw No. 1, 1 1/8 in. staple.

Effect of press conditions on properties

Tables I and II present the data collected regarding the effect of press conditions on laminate properties. These data were accumulated in an effort to standardize operating variables before developing further studies relative to variations in the web itself. It should be noted that the samples in Table I were cross-plied while those in Table II were plied parallel.

Several observations relative to the data shown in Tables I and II are of interest, namely:

1. An extremely wide latitude in temperature, press time, pressure and resin content would appear permissible for the development of maximum tensile strength when using BV-16526. The data relative to Melmac 402 and BV-17018 are too meager to pass similar judgment. From Table I it would appear advisable to use high pressures for the development of better impact strength, water absorption properties.

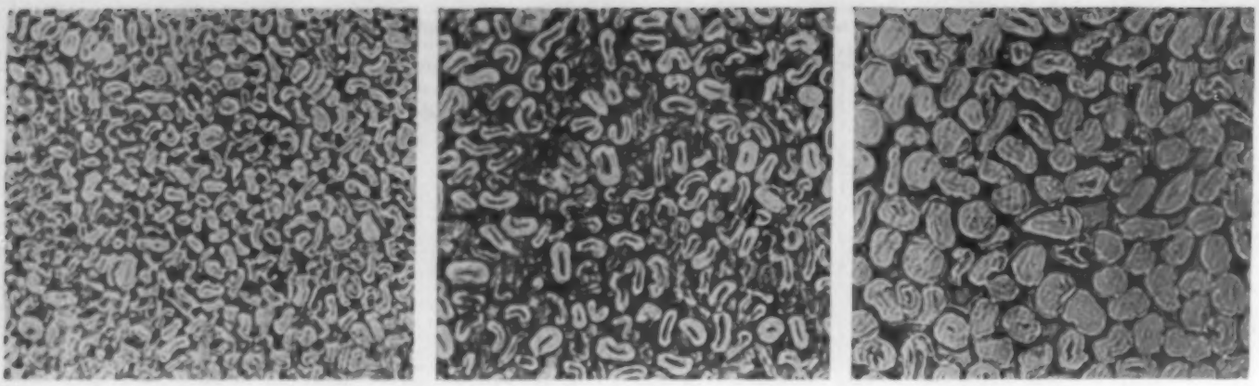
2. The significance of the resin studied, in terms of the strength values obtained, is obvious. The use of BV-16526 in so many of the experiments covered by this report was the result of an arbitrary choice based on immediate availability of material. Since this study was less concerned with obtaining maximum physical properties in the finished laminate than in studying the comparative effects of filler variations, the choice was not considered too unfortunate.

3. Despite the large differences in strength with-grain and cross-grain, *elongation* in both directions was about the same. This points to an interesting fact—namely, that while strength is closely correlated to fiber orientation in the direction of the applied force, elongation properties apparently depend more on the mere presence of the fiber base than upon the orientation of the individual fibers. It is probable that the explanation for this phenomenon lies in the fact that the *orientation* developed in the web, even after drawing, is far from perfect, and sufficient random arrangement of the fibers remains in the web to develop balanced elongation properties in the laminate. Presumably if the resin itself had an inherent elongation approaching the larger value of the fibers, a greater difference in with-grain and cross-grain elongation might be observed.

Effect of variations in web on properties

Table IV presents the results obtained under a given set of processing conditions arbitrarily selected on consideration of the data shown in Tables I and II, tempered by further consideration of industrial practice. The laminates reported in Table IV were made from webs of seven different fiber lengths.[3] The effects

[3] The fiber length referred to in Table IV as the upper-half mean is defined as the mean length of the fibers in the upper half, by weight, of an array prepared mechanically from a Suter-Webb sorter (A.S.T.M. Designation D 414-40 T).



4—Cross-sections of cottons of different fineness (times 252)

of three degrees of fiber orientation are given: undrawn, once-drawn and twice-drawn (the data being incomplete in some cases).

The salient features of the data in Table IV are as follows:

1. Moisture absorption in all cases was high. The percentage of water absorbed was independent of the staple length, staple orientation or cotton-resin weight ratio. In the wet state, therefore, the electrical properties of the various laminates were poor. As may be noted from Table VI, moisture absorption appeared to be more dependent upon the resin used than upon the characteristics of the web, indicating that poor electrical insulation is not necessarily an inherent characteristic of web-base laminates.

2. Tensile strength tended to increase as the staple length of cotton in the web increased. This trend was most consistent for the undrawn-web samples. It should be noted, however, that although the fiber length increased over 200 percent, the laminate strength increased only about 25 percent.

3. An increase in fiber (*Please turn to page 202*)

Table III.—Effect of Test Specimen Thickness and Width on Tensile Strength and Elongation

Resin[a]	*Resin pick-up*	*Number of plies*	*Thickness*	*Width*	*Tensile strength*[c] *with grain*		*Elongation*[c]
					Value	*Standard error*	
	percent		*in.*	*in.*	*p.s.i.*	*p.s.i.*	*percent*
BV-16526	242	5	0.008	0.461[b]	1,930	100	1.4
	242	10	0.011	0.461[b]	2,630	280	...
	242	20	0.023	0.461[b]	26,200	1300	2.1
	242	30	0.030	0.461[b]	25,700	2000	1.9
	242	50	0.051	0.461[b]	25,500	1100	2.7
	242	75	0.084	0.461[b]	26,200	2000	2.7
	242	60	0.058[b]	0.451	28,400	...	1.8
	242	60	0.058[b]	0.441	28,400	...	2.2
	242	60	0.058[b]	0.357	29,600	...	2.8
	242	60	0.058[b]	0.338	28,800	...	2.8
BV-17018	225	10	0.016	0.461[b]	16,500	500	1.8
	225	30	0.050	0.461[b]	19,300	1100	2.1
	225	60	0.085	0.461[b]	18,000	100	...
	225	90	0.110	0.461[b]	19,600	100	...
	225	120	0.160	0.461[b]	19,000	200	...
	225	...	0.114	0.463	18,600	...	...
	225	...	0.114	0.363	18,700	...	...
	225	...	0.114	0.295	18,400	...	...
	225	...	0.114	0.280	17,900	...	...
Resinox	109	5	0.018	0.461[b]	7,000	200	1.7
	109	10	0.024	0.461[b]	13,900	100	3.5
	109	20	0.048	0.461[b]	13,500	200	3.9
	109	30	0.072	0.461[b]	17,700	600	3.7
	109	50	0.089	0.461[b]	25,500	100	...
	109	90	0.153	0.461[b]	25,600	400	...

[a] Data on preparation of samples:
Pressure: 250 p.s.i.
Press time: approximately 1 min. for each 0.01 in. thickness.
Temperature: 305–310° F.
Roller card web: Drawn once; average wt. before impregnation 19–20 grains/foot; 10 in. wide; *not* cross-plied.
Cotton used: M. W. Bobshaw No. 1; 1 1/8-in. staple.
[b] Average values.
[c] Specimens were broken on a Scott tester.

Table IV.—Effect of Staple Length and Orientation on the Physical and Electrical Properties of Cotton Web-Based Laminates[a] Made with Resin BV-16526

Staple length,[b] in.	1/2		13/16			7/8		1		1 1/8		1 1/4	1 9/16
Type of web	*Undrawn[c]*	*Once drawn[d]*	*Undrawn*	*Once drawn*	*Twice drawn[e]*	*Undrawn*	*Once drawn*	*Undrawn*	*Once drawn*	*Undrawn*	*Once drawn*	*Undrawn*	*Undrawn*
Resin add-on, percent	140	64	144	62	...	191	63	141	120	74	67	140	144
Volatile matter, percent	4.4	7.0	4.8	7.4	...	5.2	5.5	...	5.6	5.9	8.3	...	5.5
Density	1.29	1.17	1.11	1.23	1.25	1.23	1.34	1.28	1.25	1.25	1.31	1.26	1.34
Water absorption, percent	10.1	9.0	9.2	13.3	12.7	8.4	11.8	8.6	10.9	13.1	9.0	7.8	8.6
Thickness change[f]	+0.4	+0.8	−1.5	−0.6	+1.2	+0.9	+0.4	−0.7	−1.5	+0.6	−0.8	−1.2	−1.3
Tensile strength[g]													
With grain, p.s.i.	14,500	13,450	15,300	16,600	19,200	16,000	15,400	16,650	17,500	17,900	19,800	16,350	17,700
45° to grain, p.s.i.	13,735	12,875	18,070	14,020	...	15,920	16,340	16,900	16,100	16,235	...	16,785	19,035
Elongation at break													
With grain, percent	4.8	4.3	3.3	3.6	3.6	5.3	4.6	5.4	4.0	3.3	...	4.9	4.1
45° to grain, percent	5.1	6.5	5.2	5.5	...	6.4	6.4	5.0	7.1	4.7	...	6.0	6.0
Flexural strength, p.s.i.	16,220	19,710	25,170	25,845	24,855	25,810	21,440	24,530	27,865	20,235	24,740	23,150	23,080
Modulus of elasticity in flexure, p.s.i.	722,200	805,600	1,264,000	1,290,500	1,271,000	1,345,000	1,026,000	1,045,000	1,456,000	898,900	1,209,500	979,000	1,000,500
Izod impact strength[h]													
Flatwise, ft. lb./in. notch	23.55	21.76	9.94	15.57	...	14.47	8.10	19.50	12.72	16.38	22.13	18.27	17.60
Edgewise, ft. lb./in. notch	4.15	5.89	3.03	3.83	...	3.16	2.62	2.91	2.82	3.26	3.72	2.90	2.97
Bonding strength, p.s.i.	...	...	...	820	...	970	1,275	1,185	1,210	935	680	1,140	1,080
Dielectric strength													
Parallel to laminations, kv.	...	...	..	12.9	...	13.3	12.9	13.6	14.3	12.2	13.6	12.5	13.3
Perpendicular to laminations, v./mil	...	...	120.0	121.0	...	...	135.0	121.0	123.0	...	115	...	...
Power factor													
At 1 mc., Condition B[i]	0.0511	0.0514	0.0471	0.0494	...	...	...	0.0485	0.0480	0.0498	...	0.0426	0.0426
At 1 kc., Condition B	0.0141	0.0129	0.0124	0.0124	...	...	...	0.0109	0.0115	0.0096	...	0.0096	0.0096
At 1 mc., Condition D[j]	...	...	...	...	...	...	...	0.3980	...	0.4640	...	0.5860	...
At 1 kc., Condition D	...	...	...	...	...	...	...	[k]	...	[k]	...	[k]	...
Dielectric constant													
At 1 mc., Condition B	4.64	4.51	4.49	4.46	...	...	...	4.53	4.89	4.27	...	4.38	4.31
At 1 kc., Condition B	5.06	4.84	4.82	4.79	...	...	...	4.92	5.31	4.56	...	4.67	4.61
At 1 mc., Condition D	...	...	...	...	...	...	...	12.10	...	10.60	...	12.70	...
At 1 kc., Condition D	...	...	...	...	...	...	...	[k]	...	[k]	...	...	...

[a] All samples pressed at 1000 p.s.i. at 310° F. For approximately 1 min. for each 0.01 in. thickness. Approximate number of plies in 1/2-in. sheets: 65 for undrawn web; 130 for drawn web. Approximate number of plies in 1/2-in. sheets: 260 for undrawn web; 520 for drawn web.
[b] Mean length of the fibers in the upper half, by weight, of the sample, obtained from a Suter-Webb array by A.S.T.M. D 414–407.
[c] Weight of undrawn web ranged from 0.37 to 0.42 grain per sq. in. Cross-plied 2 by 2 layers.
[d] Original weight of card web to be drawn: 0.95 to 1.08 grains per sq. in. Subjected to draft of 6.03. Cross-plied 3 by 3 layers.
[e] Plied layers of *'once drawn'* web subjected to further draft of 6.03. Cross-plied 3 by 3 layers.
[f] Changes in width and length too small to measure with available equipment.
[g] Tested on a Dillon Model K. With-grain samples cut parallel to any edge of sheet.
[h] Correction for friction and windage applied in all cases.
[i] Condition B: 24 hr. in oven at 100° C., followed by 5 hr. in calcium chloride desiccator. Tested dry.
[j] Condition D: 24 hr. in distilled water at 25° C. Tested wet after removing surface water.
[k] Too poor to measure.

Manufacture of phenolic molding compounds in Germany*

Based on the production manual of Dynamit A.-G., Troisdorf. This translation was prepared for publication by Dr. G. M. Kline and Mrs. I. G. Callomon, National Bureau of Standards

THE manufacture of phenolic resins by Dynamit A.-G., a subsidiary of I. G. Farbenindustrie A.-G., was described in a previous report.[1] This report covers the formulation and preparation of molding compounds based on these resins. These molding compounds are marketed in Germany under the trade name *Trolitan*.

Directions for the preparation of each molding compound are given in the following paragraphs.[2] The composition data are presented in Table I, except for compounds Type 54 Series 1500, Type 57 Series 1300 and Type 57 Series 1400 for which the complete description is given in the text.

Trolitan type 16 series 1400

Preparation of the resin solution—Heat the alcohol to approximately 70° C. Add the dye, previously dissolved in alcohol, and mix well. Then add the previously admixed resin, magnesium stearate, hexamethylenetetramine and tricresyl phosphate with constant stirring. Mix for one hour. Ten minutes before the resin solution is removed, add the magnesium oxide dispersed in water. Pass the resin solution through a 0.5-mm. mesh screen to remove undissolved particles and foreign substances. The hot resin solution is not allowed to stand unnecessarily because it will become more viscous and hence result in poorly impregnated material and resin segregation.

Preparation of the molding compound—Loosen the as-

* The information contained in this report was obtained in a three months investigation of the important plastics plants in Germany made by the senior translator under the auspices of the Office of the Chief of Ordnance, War Department. The Department of Commerce is merely distributing this technical information which has come into its hands from captured German territory. This information should be made available to all United States citizens interested in it, but use of it by anyone must be and is at one's own risk in so far as the United States or foreign patent violations are concerned.

[1] "Manufacture of phenolic resins for molding and laminating in Germany" MODERN PLASTICS 23, 155–158 (Aug. 1946).

[2] For additional information regarding phenolic molding compounds made in Germany see "Plastics in Germany 1939–1945," by G. M. Kline, MODERN PLASTICS 23, 152L (Oct. 1945).

Table I.—Composition of I. G. Phenolic Molding Compounds

	Type 16 Series 1400	*Type 31 Series 1400*	*Type 31 Series 1600*	*Type 31 Series 4400*	*Type 31.5 Series 1600*	*Type 31.9 Series 1600*	*Type 31 Series 4600*
RESIN							
Type	T1	T4N	T4N	T24N	T1	T21A	T24N
Viscosity, cp.	30–40	90	90	100	30–40	60	100
Amount,[c] kg.	20.7	38.0	46.0	38.0	39.2	52.8	46.0
Type	T4	...	...	...	Acaroid	...	...
Viscosity	60	...	...	...	...	...	...
Amount,[c] kg.	17.0	...	...	...	15.2	...	...
FILLER							
Woodflour,[c] kg.	...	54.5	44.6	54.5	43.1	46.5	44.6
Macerated fabric, kg.	...	...	...	...	...	...	...
Asbestos, kg.	55.9[b]	...	...	...	...	...	...
Soda pulp (350 g./m.^{2}), kg.	...	...	...	...	...	...	...
Calcium fluoride	...	...	...	...	...	...	...
Bronzite	...	...	...	...	...	...	...
OTHER INGREDIENTS							
Hexamethylenetetramine, kg.	2.9	5.8	6.7	5.8	...	...	6.7
Magnesium oxide, kg.	0.3	1.0	2.0	2.0	...	1.0	1.0
Magnesium stearate, kg.	0.7	1.0	1.0	1.0	...	...	...
I. G. Wax S, kg.	...	...	...	...	1.0	...	...
Tricresyl phosphate, kg.	1.6	...	...	...	1.5	...	...
Alcohol (denatured), kg.	45.3	...	...	...	...	...	...
Water, kg.	...	...	...	...	...	...	...

[a] Calculated on anhydrous basis.
[b] Approximate length of fibers: 3–5 cm.
[c] Based on the wet material.

bestos by hand and place part of it in an 800-liter Werner and Pfleiderer mixer. Add the resin solution and then slowly the rest of the asbestos. Impregnate with the machine closed for approximately 40 min., running the blades as follows: inwardly 15 min., outwardly 5 min., inwardly 15 min., outwardly 5 minutes. Spread loosely in drying pans and vacuum dry for 5 hr. at 65° C. and 50–70 mm. of mercury pressure. After drying, 50-kg. batches are shredded for about 10 min. in an Eirich mixer and, if necessary, further vacuum dried. Each 100 kg. is uniformly mixed in the Werner and Pfleiderer mixer for 2 minutes. The blades run inwardly for 1 min. and outwardly for 1 minute. A longer mixing time impairs mechanical properties.

Trolitan type 31 series 1400

Kneading-rolling process—The weighed materials are kneaded together and then rolled under the conditions shown in Table II. The material normally runs only on the faster cooler roll and only in exceptional cases, when the resin flows poorly, must the temperature of the rolls be interchanged. The material taken from the rolls is broken into pieces 30 by 50 mm. in size in a mechanical breaker or by hand. The compound is ground to pass 3-mm. mesh screen. After grinding, 5000 kg. quantities are uniformly mixed in a large blender for 1 hour. The molding compound is emptied from the blender into shipping barrels or bags through another screen which corresponds in mesh size to the desired particle size.

Mixing-rolling process—Grind the resin and hexamethylenetetramine in an MAG grinder to pass through a 4-mm. mesh screen. After grinding, mix for 30 min. with the coloring material, additional components and woodflour in a Werner and Pfleiderer mixer with the addition of 1 to 2 percent of water, depending on the moisture content of the resin. Roll under the conditions shown in Table II. Further processing takes place exactly like that described for the kneading-rolling process.

Trolitan type 31 series 1600

The molding compound is prepared by either the kneading-rolling or mixing-rolling process as described for Trolitan Type 31 Series 1400. The processing conditions are given in Table II. The material taken from the rolls is ground to pass a 2.5-mm. mesh screen.

Trolitan type 31 series 4400

The molding compound is prepared by either the kneading-rolling or mixing-rolling process as described for Trolitan Type 31 Series 1400. The processing conditions are given in Table II.

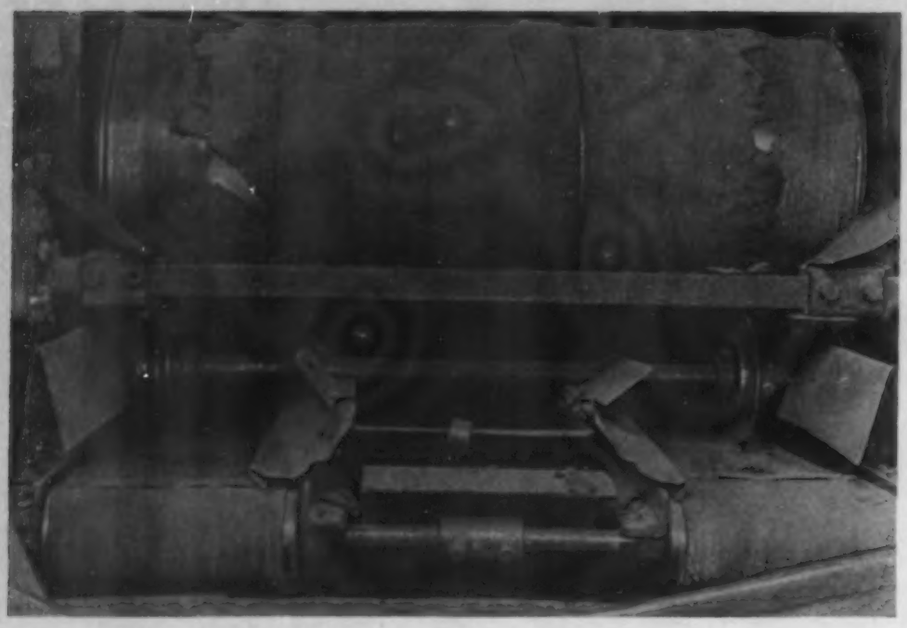
Trolitan type 31.5 series 1600

The acaroid resin is ground to pass a 0.5-mm. mesh screen. Then 150 kg. of this ground resin is mixed with 15-kg. tricresyl phosphate in the rubber kneader for about 30 min. at 35–50° C. This mixture is finely ground in a ball mill, then screened to pass a 2.5-mm. mesh screen. The required amount of this mixture (16.7 kg.) is placed in the kneader and the coloring material and other components are added. Kneading and rolling are done under the conditions shown in Table II. At the beginning the material runs on both rolls. After being cut off several times, it transfers to the rear

Table I (*Continued*).—Composition of I. G. Phenolic Molding Compounds

Type 41 Series 1109	*Type 51 Series 1500*	*Type 71 Series 1500*	*Type 74 Series 1500*	*Special Compound B* Mix No. 1	*Special Compound B* Mix No. 2	*Special Compound N*	
							RESIN
T4	T4	T4	T4	221	HLS	—T4	Type
60	110	110	110	...	100	60–70	Viscosity, cp.
22.0	39.7	37.2	37.2	21.75	267.3	33.0	Amount,[a] kg.
...	...	...	...	...	...	...	Type
...	...	...	...	...	...	...	Viscosity
...	...	...	...	...	...	...	Amount,[c] kg.
							FILLER
65.2 fine 7.2 coarse	...	...	...	30.25[f]	...	14.9	Woodflour[a], kg.
...	...	18.2	54.5	...	...	...	Macerated fabric, kg.
...	...	...	...	...	...	...	Asbestos, kg.
...	52.6	36.3	...	...	...	...	Soda pulp (350 g./m.^{2}), kg.
...	...	...	...	...	525.0	...	Calcium fluoride
...	...	...	...	...	...	44.4	Bronzite
							OTHER INGREDIENTS
3.5	6.4	6.5	6.5	3.48	54.0	6.4	Hexamethylenetetramine, kg.
1.0	0.4	0.6	0.6	0.45	6.0	0.5	Magnesium oxide, kg.
1.0	0.9	1.2	1.2	0.60	12.0	0.8	Magnesium stearate, kg.
...	...	...	...	...	...	...	I. G. Wax S, kg.
...	...	...	...	...	...	...	Tricresyl phosphate, kg.
...	41.1	28.0[d]	13.0[e]	...	...	...	Alcohol (denatured), kg.
4%[c]	74.5	12.0[d]	19.7[e]	...	...	...	Water, kg.

[d] 36.6 kg. of alcohol may be used in place of the 28.0 kg. of alcohol and 12.0 kg. of water.
[e] 26.0 kg. of alcohol may be used in place of the 13.0 kg. of alcohol and 19.7 kg. of water.
[f] Long wood fibers.



Continuous automatic rolling of phenolic molding compounds is accomplished in this machine. Materials are fed to rolls at center and cut off at each side, falling on conveyor belts which carry the compound to grinding, blending and packaging units

roll which is turning faster and is hotter. It is necessary to cut this sheet often to achieve an even distribution of the acaroid resin particles. The sheets taken from the rolls are broken into pieces 30 by 50 mm. in size in a mechanical breaker. The molding compound is ground to pass a 1–3-mm. mesh screen, according to the order. It is vacuum dried at least 8 hr. at approximately 65° C. and 50–70 mm. of mercury pressure. After drying, the material is immediately mixed for 1 hr. in batches of about 5 tons. The mixture is emptied from the blender into metal containers through another screen which corresponds in mesh size to the required particle size. The containers are carefully sealed so that the material will not absorb moisture and thus deteriorate electrically.

Trolitan type 31.9 series 1600 (ammonia-free)

Grind the resin with half of the woodflour. After grinding, mix for 30 min. with the coloring material, magnesium stearate and the second half of the woodflour in a Werner and Pfleiderer mixer. Roll under the conditions shown in Table II. The material taken from the rolls is broken into pieces 30 by 50 mm. in size on a mechanical breaker or by hand. The molding compound is ground to pass a 2.5-mm. mesh screen. It is vacuum dried 6 to 7 hr. at 60–65° C. and 40–50 mm. of mercury pressure. After drying, 5000 kg. of the material is divided into batches of 1000 kg. which are mixed in the large blender for 1 hour. The mixture is emptied from the blender into ship- (*Please turn to page 196*)

Table II.—Processing Conditions for Manufacture of I. G. Phenolic Molding Compounds

	Type 31 Series 1400	*Type 31 Series 1600*	*Type 31 Series 5400*	*Type 31.5 Series 1600*	*Type 31.9 Series 1600*	*Type 31 Series 4600*	*Type 41 Series 1109*	*Compound B*	*Compound N*
				KNEADING PROCESS					
Kneading temperature, °C.	100–110	100–110	100–110	75–90	...	100–110	...	...	...
Kneading time									
Net, min.	1.5–5	1.5–5	1.5–5	10	...	1.5–5	8	...	...
Gross, min.	10–12	10–12	10–12	16–18	...	10–12	15	...	...
Rolling temperature									
Front roll (15 r.p.m.), °C.	100	95	100	50	...	95	60	...	...
Rear roll (20 r.p.m.), °C.	80	65	85	65	...	70	70	...	...
Rolling time									
Net, min.	1.2	2.0–2.5	1.2	3	...	2.0–2.5	0.25	...	...
Gross, min.	2.0	3.0–3.5	2.0	4	...	3.0–3.5	0.5	...	...
Amount on roll, kg.	6	10	10	10	...	10	6	...	...
				MIXING PROCESS					
Rolling temperature									
Front roll (15 r.p.m.), °C.	100	95	100	...	55–60	95	...	70–80	90
Rear roll (20 r.p.m.), °C.	80	65	80	...	50	65–70	...	80–90	110
Rolling time									
Net, min.	1.5–2.5	2.5–5.0	1.5–2.5	...	2.0–2.5	2.5–5.0	...	7.5–8	8
Gross, min.	2.5–3.5	3.5–6.0	2.5–3.5	...	3.0–3.5	3.5–6.0	...	9.5–10	10
Amount on roll, kg.	8–10	10	8–10	...	10	10	...	19	18

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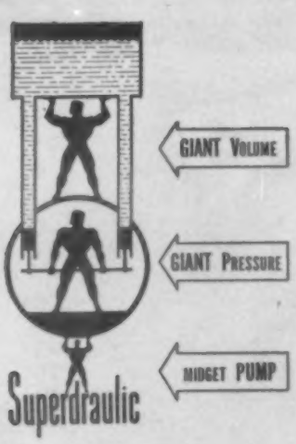


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Plastics Digest

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General

PROTEINS AS INDUSTRIAL RAW MATERIALS. A. K. Smith. Chemical Industries *58*, 974–7 (June 1946). The applications of materials derived from proteins are reviewed. These include adhesives, paper coatings, plastics, synthetic fibers, protective coatings and many other uses. Thirteen references.

CELLOPHANES. W. G. Hunter. Modern Packaging *29*, 110–11 (June 1946). The characteristics of 38 grades of regenerated cellulose film are described.

GLYCEROL IN PROTECTIVE AND DECORATIVE COATINGS. G. Leffingwell and M. A. Lesser. Natl. Paint Bull. *10*, No. 1, 5–7, 11, 14 (1946). The use of glycerol in coatings is reviewed. A large amount is used in synthesizing ester gums and alkyd resins. Forty-nine references.

PRINCIPLES AND PRACTICE OF SOIL STABILIZATION. H. F. Winterkorn. Colloid Chemistry *6*, 459–92 (1946). The principles and methods of soil stabilization are discussed. Synthetic resins, as well as many other materials, are used for this purpose.

ANTIMONY OXIDE—ITS USE AS FLAME-RESISTING COATING. C. C. Downie. Paint Manuf. *16*, 13–16 (1946). The use of antimony oxide in formulating flame-resisting coatings is discussed in this article.

Materials

CELLULOSE PHTHALATES. G. Champetier and F. Appell. Bull. soc. chim. *11*, 136–8; Chem. Abstracts *40*, 2624 (May 10, 1946). Cellulose reacts with phthalic anhydride in the presence of pyridine to give cellulose acid triphthalate. The product is a white powder which decomposes on heating and forms triesters with ethanol and butanol. The glycol and glycerol esters are infusible as well as insoluble.

THE PREPARATION AND POLYMERIZATION OF FOUR ISOMERIC DIMETHYLSTYRENES. C. S. Marvel, J. H. Saunders and C. G. Overberger. J. Am. Chem. Soc. *68*, 1085–8 (June 1946). The preparations of 3,5-, 2,4-, 2,5- and 3,4-dimethylstyrene are described. Hard resins were formed when the monomers were polymerized in ultraviolet light. The resins are all soluble in benzene and insoluble in methanol. The molecular weights are 17,700, 9000, 18,500 and 15,500, respectively. The softening ranges are 148–152° C., 178–180° C., 171–176° C. and 163–175° C., respectively.

THE PREPARATION AND POLYMERIZATION OF SOME ALKYL STYRENES. C. S. Marvel, R. E. Allen and C. G. Overberger. J. Am. Chem. Soc. *68*, 1088–91 (June 1946). The preparations of *m*-tert-butylstyrene, *m*-sec-butylstyrene and *p*-cyclohexylstyrene are described. Hard resins were formed when these monomers were polymerized in ultraviolet light. All the resins were soluble in benzene and insoluble in methanol. The molecular weights are 12,800, 32,400 and 28,000, respectively. The softening ranges are 123–165° C., 150–165° C. and 186–230° C., respectively.

POLYSILOXANES FROM METHYLDICHLOROSILANE. R. O. Sauer, W. J. Scheiber and S. D. Brewer. J. Am. Chem. Soc. *68*, 962–3 (June 1946). Polymethylpolysiloxanes were prepared and characterized.

POLYMERIZATION OF ISOBUTYL AND ISOAMYL VINYL ETHERS. I. P. Losev, O. Y. Fedotova and M. F. Shostakovskiĭ. J. Gen. Chem. (U.S.S.R.) *14*, 889–96 (1944); Chem. Abstracts *40*, 1777–8 (April 10, 1946). The anhydrous chlorides of aluminum, iron, tin, copper, zinc and silicon and boron trifluoride are the main catalysts in the polymerization of isobutyl and isoamyl ethers. Benzene is used for solvent polymerization. Both of these polyvinyl ethers are resinous, viscous, sticky masses, do not form films, are not compatible with other polymers.

Applications

TRANSPARENCY RETURNS TO THE COSMETIC FIELD. Modern Packaging *19*, 154–5 (Mar. 1946). Transparent cosmetic and perfume boxes made of acrylic and cellulose acetate plastics are described. One made of cellulose acetate has many tiny bubbles in the plastic.

MOISTURE-PROOF PAPER PACKS. Plastics (London) *10*, 141 (Mar. 1946). Polyethylene coated paper is made by a hot-melt process. The water vapor permeability of the product is about 8 g./m.²/24 hr. at 100° F. and 90 percent relative humidity after creasing. Possible application is for foodstuffs and chemicals.

PROTECTIVE FILMS. F. C. Edelston. Modern Packaging *19*, 156–8 (Mar. 1946). Transparent cast films of vinyl chloride acetate resin are used to package washing machines, typewriters and quick-freezers. These films are tougher and stronger than prewar films. The plastic wrapper may be retained by purchaser of the article as a dust cover.

WET STRENGTH IMPROVEMENT OF PAPER. C. H. Butcher. Plastics (London) *10*, 173–5, 224 (Apr. 1946). The use of resins for improving wet strength of paper is reviewed. Urea-formaldehyde, melamine-formaldehyde, aminotriazine-aldehyde, starch-methylolmelamine, and vinyl acetate resins are considered.

PACKAGING METAL PARTS WITH STRIP COATINGS. C. E. Waring. Modern Packaging *19*, 204–7 (Mar. 1946). Hot-melt strip coatings are described for packaging metal parts to resistance corrosion and impact damage. These coatings are based on ethylcellulose and cellulose acetate butyrate.

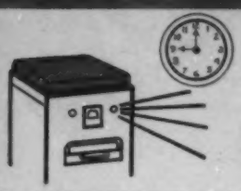
Coatings

NONFLAMMABLE COATINGS HAVING A POLYVINYL CHLORIDE BASE. G. M. Norkina. Khimicheskaya Prom. *1944*, No. 10/11, 12–14; Chem. Abstracts *40*, 2317 (April 20, 1946). Various coating compositions based on polyvinyl chloride were prepared and tested. Formulations are given. The coatings are not flammable, have no afterglow, withstand exposure outdoors for one year without deterioration, withstand contact with acid or alkali, are not affected by oil or hydrocarbons, and are fungi-resistant. Baking was found to improve the properties.

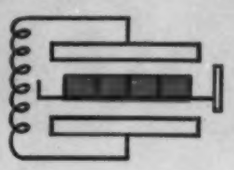
ORGANOSOLS . . . NEW DISPERSION COATINGS. J. Hoyt. Modern Packaging *19*, 193, 262 (Mar. 1946). Dispersions of vinyl chloride acetate resins in plasticizer and 20 to 30 percent non-solvent organic liquid carriers are applied to paper on textiles and passed through an oven. The carrier evaporates and the resin dissolves in the plasticizer. On cooling, a strong tough coherent coating results. The dispersion may be pigmented. Thick coats may be formed in one operation. Cost is less than similar products made from the usual solutions containing 70 to 80 percent volatile solvents.

PROTECTIVE COATINGS INDUSTRY. V. C. Bidlack. Chem. and Eng. News *24*, 344–6 (Feb. 10, 1946). The developments in the protective coatings industry during 1945 are described.

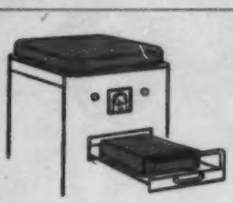




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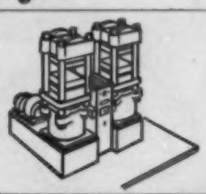
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Technical Briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

HIGH SPEED RAIN ABRASION OF GLASS CLOTH LAMINATES. R. M. Robertson, R. J. Lobisser and R. E. Stein. Ind. Eng. Chem. *38*, 590–1 (June 1946). Preliminary experiments to determine the cause of wear, observed on airborne radar antenna housings flown at high speed through rain, were made with a testing machine which carried samples through a water spray at 260 m.p.h. The material was a glass cloth laminate designed for high stiffness and heat resistance. Laminated samples of a number of different resins were tested and showed wear. Various protective coatings were studied, as well as laminates of cotton cloth. A $^1/_{32}$-in. rubber sheet cemented to the laminate gave complete protection as did various rubbery coatings built up to a thickness of 0.010 in. or more.

STAYBWOOD—A HEAT-STABILIZED WOOD. A. J. Stamm, H. K. Burr and A. A. Kline. Ind. Eng. Chem. *38*, 630–4 (June 1946). Extensive data are presented on the reduction in hygroscopicity of wood when heated beneath the surface of a molten metal over the temperature range 120 to 320° C. and time range of 1 min. to 1 week. The degree of reduction in hygroscopicity and equilibrium swelling and shrinking for a given time of heating is practically doubled for each 10° C. rise in temperature. Reductions in hygroscopicity are shown to be accompanied by appreciable increases in decay resistance and significant losses in strength. Serious losses in strength for many possible uses are not obtained until the reductions in hygroscopicity and anti-shrink efficiency exceed 50 percent.

GLUE-LINE STRESSES IN LAMINATED WOOD. A. G. H. Dietz, H. Grinsfelder and E. Reissner. Trans. A.S.M.E. *68*, 329–35 (May 1946). From an examination of glued timbers undergoing changes in moisture content, it appears that delamination, when it occurs, most frequently does so when the moisture content is being reduced. The dehydrating phase of a moisture-change cycle is the more severe. Not only does glue-line delamination occur more frequently during shrinkage but so also does checking of the wood. Extensive experimentation and field trials led to the conclusion that thin laminations are better than thick for gluing, and that wood species with low moduli are better than species with high moduli. Increased strength of the wood when dry abetted by loss of plasticizing water in the glue line apparently are cumulative and a severe test for a glue. Lower bonding temperatures or shorter high-temperature schedules may be used if the glue-line stresses are reduced. Adhesives must be employed which have high shearing strength and high tensile strength perpendicular to the glue line, both when dry and when wet, if laminated beams are to be dependable in service.

Chemistry

PROPAGATION AND TERMINATION COEFFICIENTS FOR VINYL ACETATE PHOTOPOLYMERIZATION. G. M. Burnett and H. W. Melville. Nature *156*, 661 (1945). In an investigation of the photopolymerization of vinyl acetate, it is concluded that no transfer reactions occur and that active polymers do not unite when they render each other inactive.

RELATIVE EFFICIENCY OF SOME POLYMERIZATION INHIBITORS. R. L. Frank and C. E. Adams. J. Am. Chem. Soc. *68*, 908 (May 1946). The inhibiting effect of 12 chemicals on the polymerization of styrene, 3,4-dichlorostyrene and 5-ethyl-2-vinylpyridine was investigated. Picric acid and trinitrobenzene had the greatest inhibiting effect and are being used successfully in the distillation of a wide variety of monomers.

EXPERIMENTAL STUDY OF COPOLYMERIZATION. T. Alfrey, Jr., E. Merz and H. Mark. J. Polymer Research *1*, 37–43 (Jan. 1946). Using the copolymer composition equation, the critical constants α and β are determined for the systems styrene/2,5-dichlorostyrene, styrene/methyl acrylate, styrene/diethyl maleate and styrene/diethyl chloromaleate.

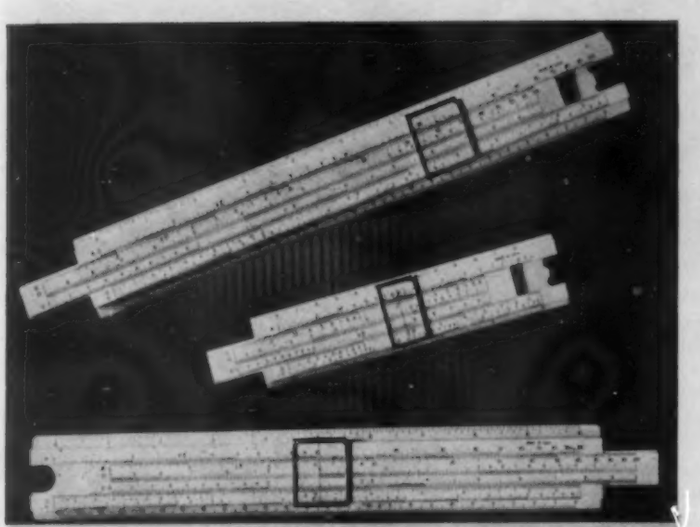
POLYMERIZATION OF OLEFINS AND DIOLEFINS IN SUSPENSION AND EMULSION. PART I. W. P. Hohenstein and H. Mark. J. Polymer Sci. *1*, 127–45 (March 1946). The literature on the mechanism of polymerization of olefins and diolefins in aqueous suspensions and emulsions is reviewed. New data are reported on 1) initial rates of polymerization of styrene, methyl methacrylate, vinyl acetate and acrylonitrile in aqueous suspensions and in soap emulsions as a function of catalyst concentration, temperature and soap concentration; 2) influence of water-soluble activators, such as sodium bisulfite; 3) influence of initial size of monomer droplets on initial rates of monomer consumption; 4) study, with the aid of electron microscope, of size of monomer droplets and polymer particles throughout polymerization; and 5) a few experiments on side reactions in the domain of higher conversions.

MECHANISM OF PEROXIDE-INITIATED STYRENE POLYMERIZATION. INFRARED ABSORPTION OF SOME POLYMER SAMPLES. H. F. Pfann, V. Z. Williams and H. Mark. J. Polymer Research *1*, 14–21 (Jan. 1946). It is probable that one or both ends of a long-chain molecule produced by catalyzed vinyl polymerization contain fragments of the initiator. If acid peroxides are used as initiators, these fragments can contain a carbonyl group. An investigation was made to determine whether these carbonyl groups which are present only in a very small amount can be detected by infrared absorption. In the case of polystyrene initiated with benzoyl peroxide, infrared absorption spectra reveal the presence of a small amount of some carbonyl groups in the polymer. The amount appears to be in agreement with chemical measurements and with the molecular weight of the material.

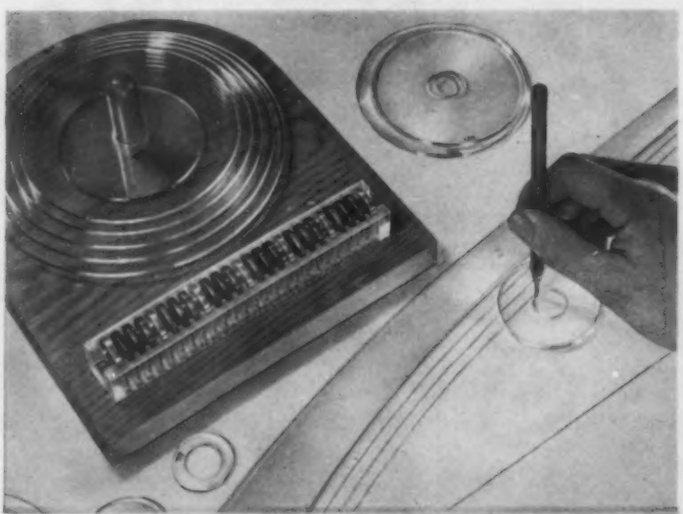
EXPERIMENTAL STUDIES ON THE FRACTIONATION OF HIGH POLYMERS. D. R. Morey and J. W. Tamblyn. J. Phys. Chem. *50*, 12–22 (Jan. 1946). The fractionation of a partially hydrolyzed cellulose acetate, of a butyl ester of the lactonized copolymer of vinyl acetate and maleic anhydride and of a cellulose acetate butyrate were investigated. The effect of initial concentration on the efficiency of fractionation by precipitation is minor. The use of very dilute solutions brings no advantages with the added difficulties. The choice of solvent and precipitant is important, and can lead to very marked differences in separability. Some systems exist whose solubility properties are independent of molecular weight, and others show a reverse-order solubility effect. Such cases are relatively rare, but are of interest both theoretically and for certain practical applications.

THERMAL EXPANSION AND SECOND-ORDER TRANSITION EFFECTS IN HIGH POLYMERS. III. TIME EFFECTS. R. S. Spencer and R. F. Boyer. J. Applied Phys. *17*, 398–404

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(May 1946). The apparent second-order transition in polystyrene is demonstrated to be a rate effect. The equilibrium volume-temperature curve was determined over the range of from about 20 to 140° C. and no indication of a transition found within this interval. Rates of heating or cooling customarily used in thermal expansion measurements result in an apparent second-order transition in the neighborhood of 82° C. The equilibrium cubical thermal expansion coefficient was found to be 4.53 by 10^{-4} per ° C. for one sample of polystyrene, but there are indications that this value varies somewhat from one polystyrene sample to another. At ordinary rates of heating below the apparent transition temperature, or at more rapid rates near and above the transition temperature, polystyrene exhibits a cubical thermal expansion coefficient of about 2.7 by 10^{-4} per ° C., and this value is not dependent on the heating rate as long as it is rapid enough. This fact suggests that two mechanisms operate in the thermal expansion of polystyrene at markedly different rates, one resulting in almost instantaneous expansion, even at room temperature, and the other being strongly temperature dependent and contributing to the expansion under normal rates of heating only at higher temperatures. The rate of expansion by the second mechanism was determined at different temperatures, resulting in an energy of activation of 12.0 kcal. This energy of activation would seem to indicate that the second mechanism involves the viscous flow of polymer chain segments rather than the uncoiling of chains as in rubber-like elasticity, which was found to have an activation energy of about 61 kcal. for polystyrene. Isothermal volume-time curves were found to be exponential in form and this fact, together with the instantaneous expansion coefficient made it possible to set up a different equation defining the volume-temperature curve under non-equilibrium conditions, i.e., at finite heating rates. A comparison was made between an experimental volume-temperature curve and a theoretical curve under the same conditions obtained by graphical solution of the differential equation. Extension of this way of predicting volume-temperature curves to problems as the expansion of quenched samples and annealing for dimensional stability was indicated.

MOISTURE ADSORPTION OF TEXTILE YARNS AT LOW TEMPERATURES. R. C. Darling and H. S. Belding. Ind. Eng. Chem. *38*, 524–9 (May 1946). The moisture adsorption of wool, cotton, cellulose acetate and viscose rayon yarns was measured at 40, 0 and −20° F. and at several relative humidities above 50 percent. The equilibrium values obtained, together with similar values at higher temperatures in the literature, indicate that at constant relative humidity there is a high point between 0 and 40° F., and that less water is bound at lower as well as at higher temperatures. The significance of this finding in terms of possible changes of heat adsorption is discussed. Curves of water adsorption rate of the yarns are also given, from which the over-all temperature coefficient of the process is derived.

Testing

FACTORS AFFECTING THE TENSILE STRENGTH OF INJECTION MOLDED ETHYL CELLULOSE TEST SPECIMENS. W. E. Gloor, W. C. Goggin and H. K. Haviland. A.S.T.M. Bull. No. 140, 45–9 (May 1946). The effects of the variables in injection molding ethyl cellulose test specimens on the tensile properties were investigated. The variations in molding are more significant than those in testing, since on the same samples the range between the average results obtained by various testers on the same materials showed a mean value of 6 percent, while the spread between the average test results of materials, molded by the different molders and tested by either a single tester or all testers, varied from 7 to 35 percent and showed a mean value of 20 percent. If the variations due to testing and molding should be additive a variation up to about 45 percent (10 percent due to testing, 35 percent due to molding) among different laboratories is possible. It appears that the heat exposure and temperature of molding are the significant factors which account for the different behavior of the same material molded by different molders.

LABORATORY TESTING OF PLASTICS—SMALL SCALE IMPACT TESTS. A. Bailey and O. W. Ward. A.S.T.M. Bull. No. 140, 50–4 (May 1946). A method and apparatus for testing impact strength quantitatively on small specimens is described. Specimen size is 1 by 0.1 by 0.2 inch. The method employs an inclined glass tube and a steel sphere which is released from a vacuum throat, allowed to run down the inclined glass tube and collide with the notched specimen. The path of flight of the sphere after impact is in a horizontal direction and the length of the trajectory is a measure of the impact strength. Data are recorded on the experimentally determined impact strengths of various plastics. The reproducibility of the method is of the order of 1 percent. The accuracy is probably similar to the standard Izod test. Illustrations explain construction.

ABRASION AND WEAR TESTING OF TEXTILE FABRICS. T. R. Dawson. J. Rubber Research *15*, 65–91 (April 1946). The factors involved in wear tests, the expression and reproducibility of results and the various types of wear testing machines are discussed and described. There are 155 references.

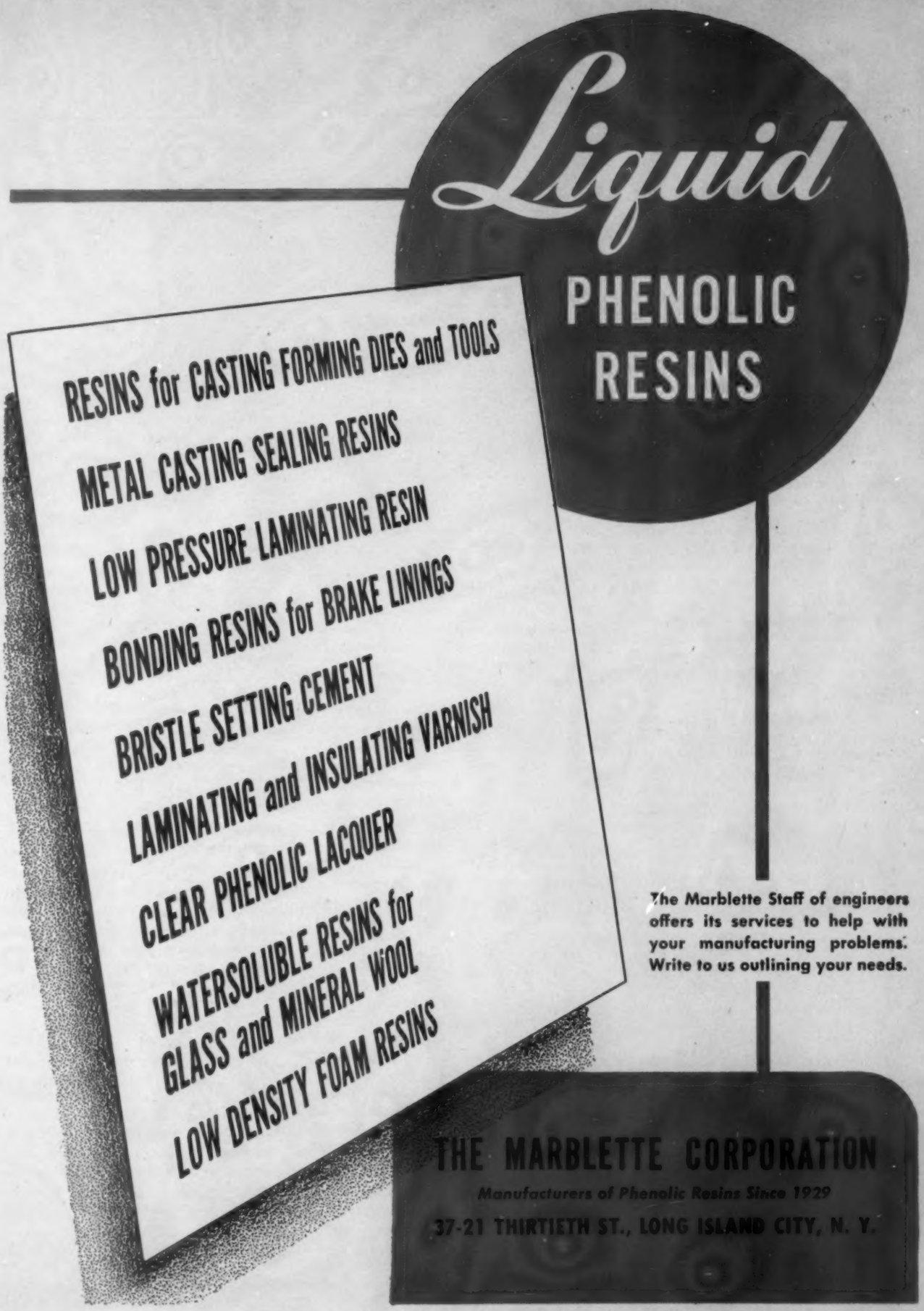
GAS PERMEABILITY—AN ISOSTATIC TEST METHOD. D. W. Davis. Modern Packaging *19*, 145–9, 176, 178 (May 1946). A new method and apparatus for determining the gas permeability of flexible packaging materials under isostatic conditions are described. Several advantages are claimed for this method. Carbon dioxide and oxygen permeability values are given for a wide variety of sheet materials including several types of plastics films. Water vapor permeabilities also can be determined.

USE OF AN ION-EXCHANGE RESIN IN DETERMINATION OF TRACES OF COPPER. H. A. Cranston. Ind. Eng. Chem., Anal. Ed. *18*, 323–6 (May 1946). A simple and rapid determination of copper in fluid milk, powdered milk and ice cream mix is described. Ignition or acid digestion of the sample is eliminated, the copper being made available by reducing the pH with perchloric acid. Copper is then concentrated on an ion exchanger in the hydrogen cycle, stripped from the ion exchanger with dilute hydrochloric acid, and determined polarographically using an additive standard technique.

Synthetic rubber

CREEP OF NEOPRENE IN SHEAR UNDER STATIC CONDITIONS. W. N. Keen. Trans. A.S.M.E. *68*, 237–40 (Apr. 1946). The creep characteristics of neoprene and natural rubber vulcanizates were investigated. Data on compressive and shear properties are presented.

SYNTHETIC RUBBER RESEARCH IN GERMANY. E. R. Weidlein, Jr. Chem. and Eng. News 24, 771–4 (March 25, 1946). The information presented is based on a report recently released by the Office of the Publication Board (P. B. Item 5521). Since production phases of the German synthetic rubber industry were thoroughly studied by earlier groups of American technical men, the primary object was to obtain information on fundamental aspects of German research on synthetic rubber, with particular emphasis on recent concepts for improved polymers which might be adapted with benefit to the American rubber program. Important consideration was also given to methods of evaluating new polymers, to laboratory tests leading to their adoption in production, and to service testing methods. No new polymers with appreciable advantages over the general purpose Bunas seem to have been developed by German research. On the other hand, German scientists were experimenting with some new concepts which may possibly show promise when fully exploited. The two most promising research leads that were uncovered were: 1) the Redox system of activated polymerization, 2) the principle of adding modifier only at later stages of polymerization reaction.


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U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each.

SCABBARD. J. Tyson. U. S. 2,399,522, April 30. A scabbard for knives comprising flexible transparent plastic material.

ADHESIVE. E. H. McArdle and A. E. Robertson (to Standard Oil Development Co.). U. S. 2,399,558, April 30. A composition comprising an organic polymer soluble in light hydrocarbon solvents and selected from the group of natural or synthetic hydrocarbon base rubbers dissolved in a branched chain paraffin containing from 5 to 9 carbon atoms.

MOLDING. R. R. Bradshaw (to Dow Chemical Co.). U. S. 2,399,592, April 30. A method for molding hollow, thin-walled thermoplastic articles.

CELLULOSE ETHER. L. A. Rauner and M. J. Hunter (to Dow Chemical Co.). U. S. 2,399,602, April 30. A composition of high dielectric strength, low moisture absorption and high flexibility at low temperatures comprising ethyl cellulose, and a plasticizer comprising a branched-chain primary alkyl ester of a saturated fatty acid having anywhere from 12 to 24 carbon atoms.

CELLULOSE DERIVATIVES. J. B. Rust and W. H. Van Delden (to Montclair Research Corp.). U. S. 2,399,603, April 30. A cellulose ether soluble in aqueous alkali solutions and containing alkamido groups linked to the cellulose through an ether linkage.

MOLDING. J. Bailey and H. A. Pratt (to Plax Corp.). U. S. 2,399,615, May 7. A longitudinal slipper die for use in extruding plastic material.

CELLULOSE NITRATE. L. L. Blyler (to E. I. du Pont de Nemours & Co. Inc.). U. S. 2,399,620, May 7. Cellulose nitrate having a viscosity of about 1.5 to 11.5 sec. is prepared from regenerated cellulose by nitrating at a temperature between 0 and 30° C. with a nitrating mixture of nitric and sulfuric acids.

POLYMERS. D. D. Coffman (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,399,626, May 7. A copolymer of an ethenyloxyacetic acid ester with a polymerizable olefin hydrocarbon of not more than 5 carbon atoms.

VINYL POLYMERS. J. R. Roland, Jr. (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,399,653, May 7. A solid, macromolecular, partially hydrolyzed ethylene/vinyl acetate interpolymer is prepared by heating in the absence of a primary alcohol, a solid, macromolecular interpolymer of ethylene with vinyl acetate in which the mol ratio of the vinyl acetate to ethylene is between 1 : 10 and 20 : 1 in a solution containing potassium hydroxide and at least 20 percent of a straight chain saturated secondary alcohol containing not less than 3 nor more than 6 carbon atoms.

VINYL RESIN. G. P. Mack (to Advance Solvents and Chemical Corp.). U. S. 2,399,684, May 7. A liquid vinyl resin dispersion which can be blended with rubber latex is prepared by forming a mixture of 1 mol of a liquid monomeric alpha-unsaturated aliphatic acid and 12 to 30 mols of a liquid monomeric acrylonitrile and subjecting to polymerization until a smooth, uniform, stable, milky dispersion is obtained.

ALKYD RESIN. E. G. Peterson (to Hercules Powder Co.). U. S. 2,399,692 May 7. A fusible, soluble alkyd resin comprising the reaction product obtained by heating a polymerized rosin, an alpha-beta-unsaturated organic polycarboxylic acid and a polyhydric alcohol.

SHOE DRESSINGS. J. Ratner. U. S. 2,399,693, May 7. A leather dressing capable of removing dirt, excess wax, etc., from shoes without ruining the tannery finish, comprising a mixture of shellac, an oil-soluble phenol-formaldehyde resin, a solvent, and a diluting cleaning vehicle.

RESINS. M. T. Harvey (to Harvel Corp.). U. S. 2,399,735, May 7. A method for producing a resin, comprising reacting an aldehyde such as formaldehyde or furfuraldehyde with a chlorinated phenol having on its nucleus an ethylenic unsaturated hydrocarbon of 14 to 28 carbon atoms.

POLYVINYL ALCOHOL. D. L. Wilson (to Courtaulds, Ltd.). U. S. 2,399,970, May 7. Lustrous artificial filaments, threads, etc., are prepared by dissolving polyvinyl alcohol in water, extruding through a multi-hole jet into a coagulating bath of acetone and water to form a thread, passing through a bath of hydroxy-ethoxy-ethyl ether and water, stretching while in second bath, drying.

ADHESIVES. L. Bradshaw, F. J. Morrow and C. F. MacLagan (to Borden Co.). U. S. 2,399,980, May 7. A dry glue-base, to be mixed with water, comprising powdered urea-formaldehyde resin mixed with aluminum phosphate, ferric phosphate, silica or clay.

COATINGS. L. S. Meyer (to Libbey-Owens-Ford Glass Co.). U. S. 2,400,016, May 7. A surface is coated with a suspension in a volatile liquid vehicle of a finely divided cellulosic material, intermediate reaction products of urea and formaldehyde, and a diureido alkane, and finishing the resultant coating by hot-pressing.

ABRASIVE. C. E. Wooddell, G. Van Nimwegen and E. T. Hager (to Carborundum Co.). U. S. 2,400,036, May 7. A bonded abrasive article comprising abrasive particles, bonded with a copolymer of butadiene and vinylidene chloride, the copolymer being vulcanized to a substantially rigid condition.

DISPERSION. J. D. Robinson and F. J. Myers (to Resinous Products and Chemical Co.). U. S. 2,400,054, May 7. An aqueous dispersion having in the disperse phase a condensate of an organic dihalide with an inorganic polysulfide, copolymers of a conjugated diolefin with styrene, acrylonitrile, or isobutylene, polymeric haloprenes, and separate particles of a highly condensed and polymerized plastic mass comprising the reaction product obtained by working and heating an oil-modified alkyd resin with an organic-solvent-soluble urea-formaldehyde-alcohol condensate.

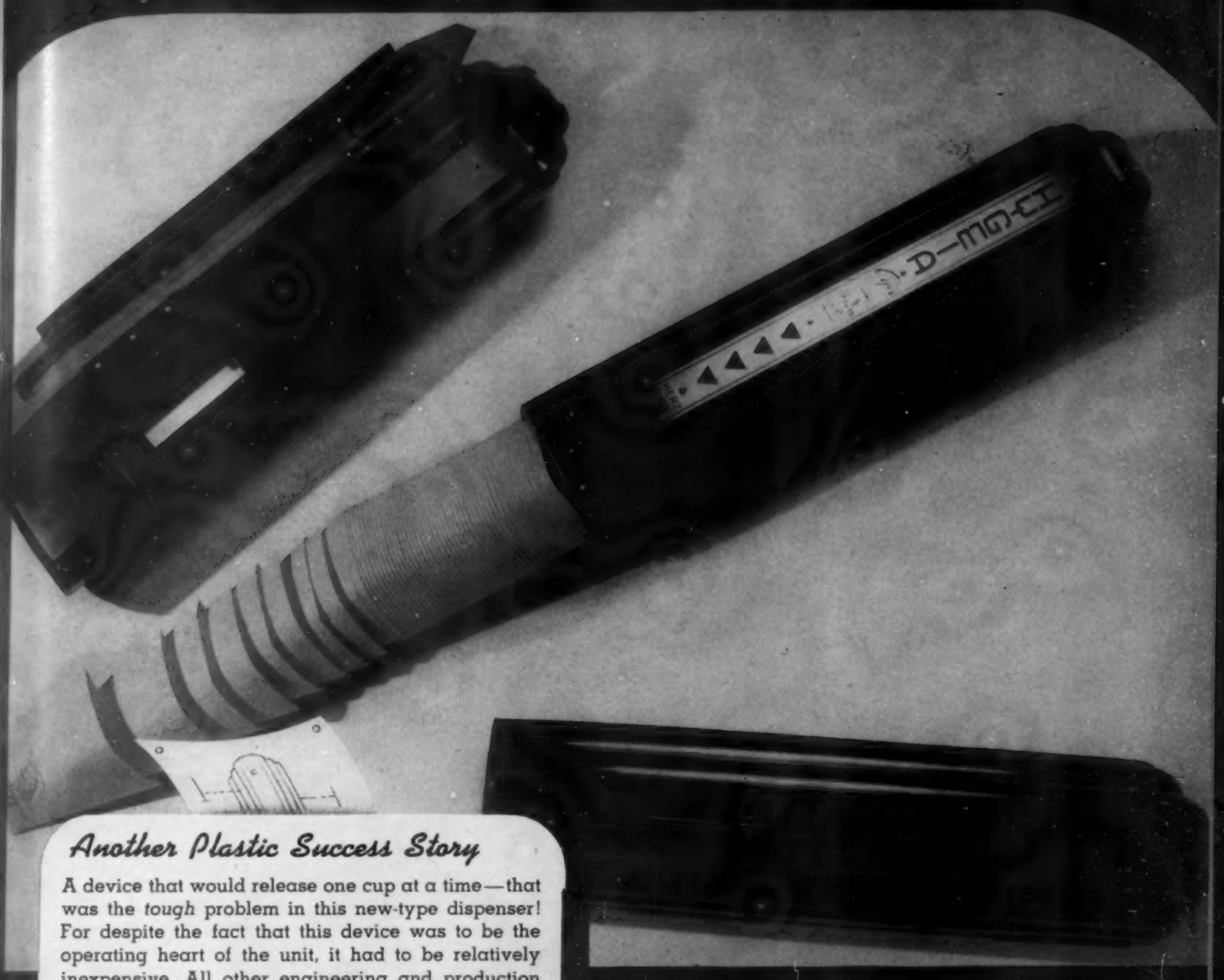
TUBING. D. A. Wallace (to Chrysler Corp.). U. S. 2,400,055, May 7. A method for forming tubing from heat-curable plastic material.

STRUCTURAL MATERIAL. H. Dreyfus, W. Walker and J. H. Rooney (to British Celanese Ltd.). U. S. 2,400,078, May 14. A molded structural material comprising wood chips closely bonded together by means of a solvent-free plasticized water-insoluble organic ester or ether of cellulose.

MOLDING. J. Alfthan (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,400,091, May 14. Porous articles of polytetrafluoroethylene are prepared by heating the polymer to 327 to 500° C., cooling to below 327° C., subdividing to a particle size of about 20 mesh, forming in the shape of the desired article under superatmospheric pressure at a temperature below 327° C., heating between 327 and 500° C. and then cooling the resulting article.

MOLDING. A. F. Benning and W. H. Markwood, Jr. (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,400,094 May 14. Polytetrafluoroethylene is molded

A Problem in Dispensing... Molded in PLASTICS



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There's no mystery in the TECH-ART formula for solving a plastics product problem. It combines imaginative product engineering, knowledge of the nature and applications of plastic materials, skilled mold building, complete modern facilities, thoroughly experienced personnel. And it's a formula that's seldom failed. Why not let TECH-ART apply it to *your* plastics product problem?

TECHNICAL NOTES—The 16-inch housing was compression-molded of a thermosetting phenolic; the dispensing device was injection-molded of a thermoplastic compound.

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by cold pressing the finely powdered polymer to a desired shape, heating in a closed mold and cooling.

MOLDING. M. M. Brubaker and W. E. Hanford (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,400,099, May 14. Molded articles of polytetrafluoroethylene are prepared by subjecting the powdered material to pressure of at least 100 p.s.i. at a temperature of less than 327° C., removing the shaped article from the mold, heating between 327 and 500° C. and cooling.

GLASS LAMINATE. J. R. Roland (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,400,139, May 14. A laminated product comprising two sheets of glass having between them a flexible, tough, transparent layer of a copolymer of ethylene and vinyl acetate.

POLYVINYL ACETAL. F. A. Bent and K. E. Marple (to Shell Development Co.). U. S. 2,400,333, May 14. A composition comprising a polyvinyl acetal and a glycidyl ether of glycerol employed as plasticizer.

CELLULOSE ACETATE. C. J. Malm and L. W. Blanchard, Jr. (to Eastman Kodak Co.). U. S. 2,400,361, May 14. Cellulose is activated for esterification by treatment with a mixture of a fatty acid containing 3 to 4 carbon atoms, formic acid and a small amount of sulfuric acid until the desired degree of activation is attained.

KERATIN. J. B. Speakman (to Perm Ltd.). U. S. 2,400,377, May 14. Keratin fibers are treated with a solution of an acid sulfite in water and an alcohol at about pH 4.

WOVEN FABRIC. R. C. Whitman (to Kendall Co.). U. S. 2,400,379, May 14. An industrial textile fabric impregnated to at least 20 percent of its weight with a synthetic resin.

IODINE CONTAINING FILM. C. J. Cavallito (to Wingfoot Corp.). U. S. 2,400,389, May 14. A laminated sheet of rubber hydrochloride, one ply of which contains iodine in a condition in which it is readily liberated.

COMPOSITION. M. De Groote (to Petrolite Corp., Ltd.). U. S. 2,400,393, May 14. A new composition comprising an oxyalkylated lower alkyl ester of a polymerized polyethylenic higher fatty acid or an oxyalkylated sulfurized lower alkyl ester of a polymerized polyethylenic higher fatty acid.

STOP NUT. W. H. Taylor and R. E. Workman (to Wingfoot Corp.). U. S. 2,400,444, May 14. A plastic stop nut.

COATING. C. Bogin (to Commercial Solvents Corp.). U. S. 2,400,453, May 14. An improved coating composition comprising cellulose acetate butyrate dissolved in a solvent mixture containing an acetate of a lower monohydric alcohol.

ADHESIVES. T. R. Ten Broeck (to Wingfoot Corp.). U. S. 2,400,474, May 14. An adhesive comprising an olefin polysulfide rubber as well as an organic diisocyanate.

ACRYLATE POLYMERS. F. C. Atwood (to National Dairy Products Co.). U. S. 2,400,477, May 21. Alkyl acrylates are polymerized by agitating under polymerizing conditions a mixture of an alkyl acrylate monomer and a polymer of the acrylate at a temperature above room temperature but not substantially above the boiling point of the monomer.

CASTING MOLD. J. L. Brannon and S. A. Mraz (to Bakelite Corp.). U. S. 2,400,482, May 21. A casting tray for casting synthetic resins.

CELLULOSE ESTERS. J. W. Fisher (to British Celanese, Ltd.). U. S. 2,400,494, May 21. Cellulose esters of higher fatty acids are purified by treatment with aqueous ethyl alcohol at 35 to 50° C.

PACKINGS. M. R. Buffington (to Lea Fabrics, Inc.). U. S. 2,400,533, May 21. A cup packing prepared by saturating a fabric with a methyl cellulose solution, drying the fabric forming into reinforcing layers in a cylindrically shaped cup, impregnating with a rubber, and finally vulcanizing the rubber.

WINDOW GLAZING. G. S. Merrill (to Minn. Mining and Mfg. Co.). U. S. 2,400,565, May 21. An elasto-plastic sash glazing composition having good adhesion to wood, glass and metal and of such viscosity that it can be applied at room temperature, said composition containing resinous material.

ADHESIVE. S. L. Sprague (to B. B. Chemical Co.). U. S. 2,400,612, May 21. An adhesive comprising polychloroprene dissolved in an organic solvent and containing polyvinyl acetate.

PHENOLIC RESINS. E. F. Siegel (to Reichhold Chemicals, Inc.). U. S. 2,400,718, May 21. Reactive phenol-aldehyde resins are prepared by reacting unmodified phenol and aldehyde in two steps by forming a Novolak in acid medium using the total amount of phenol, but only part of the total amount of aldehyde, and then condensing with aqueous formaldehyde in a strongly alkaline medium at a temperature below 40° C. to convert it into a Novolak polyalcohol.

SURFACE TREATMENT. H. D. Staudinger and H. M. Hutchinson (to Distillers Co., Ltd.). U. S. 2,400,720, May 21. A plastic article composed of a hydrophilic resin containing aromatic nuclei is surface treated with sulfuric acid, fuming sulfuric acid, sulfur trioxide or chlorosulfonic acid thereby rendering said surface permanently hydrophilic.

EXPLOSIVE RESIN. H. A. Bruson and G. B. Butler (to Rohm and Haas Co.). U. S. 2,400,806, May 21. A resinous combustible condensation product of 2,4,6-trinitrotoluene, formaldehyde and ammonia, or a strongly basic N-methylol-forming aliphatic or alicyclic amine.

VINYL CHLORIDE POLYMERS. E. R. Burns (to Dispersions Process, Inc.). U. S. 2,400,808, May 21. An aqueous dispersion of a vinyl chloride polymer prepared by mixing said polymer with a vinyl chloride polymer containing hydroxyl groups, a plasticizer and a hydrophilic colloidal dispersing agent, and adding water until such time as an inversion of phase occurs.

BRUSHES. H. Cave (to Fuller Brush Co.). U. S. 2,400,809, May 21. A strip of brush material is prepared by forming a channel in a moving length of suitable material, inserting a powdery thermoplastic adhesive in said channel, inserting bristle-like elements in orderly array in contact with the adhesive, closing legs provided on the edge of said channel onto the bristles to supply pressure to the bristles and adhesive, heating and cooling

POLYSTYRENE. F. J. Soday (to United Gas Improvement Co.). U. S. 2,400,892, May 28. A plastic composition comprising a resinous polymer of styrene and a plasticizer such as cyclohexyl naphthenate or cyclohexyl stearate.

POLYVINYL ACETAL. G. S. Stamatoff (to E. I. du Pont de Nemours & Co., Inc.). U. S. 2,400,957, May 28. A polyvinyl acetal resin is prepared by condensing an aldehyde containing from 2 to 4 carbon atoms with polyvinyl alcohol containing some unhydrolyzed ester groups, comprising adding said aldehyde gradually with agitation in the presence of acid catalyst to part of the polyvinyl alcohol, and adding the remainder of the polyvinyl alcohol before precipitation of the acetal.

PHOTOGRAPHIC ELEMENT. J. A. H. Hart and E. W. Lee (to Ilford Ltd.). U. S. 2,400,989, May 28. A photographic element comprising a support having a surface of fully esterified methyl methacrylate polymer, a substratum layer comprising a methyl methacrylate polymer containing 15 to 25 percent free carboxyl groups, and a gelatin layer adjacent to said substratum layer.

SPINNING BUCKET. H. D. Haley (to American Viscose Corp.). U. S. 2,401,069, May 28. A molded spinning bucket comprising a main body portion of molded artificial resin and an upper rim of molded laminated fabric impregnated with an artificial resin which is same as resin comprising main body portion.



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Efficiency, attractiveness, comfort and adaptability, were given due consideration when this shop was designed for developing and testing plastic products

New molding shop at research laboratory

by NORMAN MORASH*

THE design and construction of a molding shop capable of handling plastics and rubber, for use by a large industrial research and development laboratory, offers many interesting problems. The shop, which was built recently by American Cyanamid Co., was constructed solely for the purpose of product testing and evaluation. Consequently the important items to consider were extreme versatility and adaptability, accurate control of all variables, attractiveness, low sound level and comfort. An attempt was made to construct a shop that could handle efficiently all products that the Laboratory might develop for the next several years.

The shop is 84 ft. long by 32 ft. wide. It is divided into four sections: 1) the press room, 2) the pump room, 3) a small foreman's room, 4) a store room.

The press section of the new shop comprises one 6-oz. injection molding machine, one 430-ton laminating press, one 100-ton transfer press, four 50-ton and two 18-ton compression molding presses, one 500-ton, one 50-ton and two 100-ton rubber presses. The presses in our original molding shop were operated on water from low and high pressure accumulators. It was decided that the equipment in the new shop should be operated on oil and that each press should have its individual pumping unit, all located in a soundproofed room.

The laminating press is designed to handle the largest sized laminates that can be practically prepared in the Laboratory. It is a 30 by 30 in., 2-opening, 4 steam platen press. The ram is 21 in. in diameter, with a 28 in. maximum stroke. The closing speed is 53 in. per min. and the pressing speed $5^1/_2$ in. per min. at full tonnage setting. The opening speed is 48 in. per minute and the press is designed for 2500 p.s.i. with a total capacity of 430 tons.

To make the press more versatile the design is such that the steam platens may be removed and then the middle platen run up against the top head and bolted in place. It is then possible to install a comparatively large compression or transfer mold. Positive stops are

A 430-ton laminating press, capable of handling the largest laminates that can be prepared, is 30 by 30 in., has 2 openings, 4 steam platens and operates at 2500 p.s.i.



* Development Engineering Div., American Cyanamid Co.

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All AIRTRONICS Preheaters have been designed for maximum simplicity of operation. Power output and preheating time are *automatically* controlled. To operate, the molder simply places the charge between the sturdy self-positioning electrodes, closes the hood and presses the proper "start" button.



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Dual power and time controls are mounted on a pivoting panel recessed in the cabinet front. Tilted out, the panel is fully accessible for set-up adjustments. Tilted in and locked, the set-up controls are *completely out of the way*, preventing unauthorized changes.



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AIRTRONICS Dual Load Selection, Automatic Power Regulation and Wide Range Load Accommodation make possible efficient handling of a greater variety of preheating jobs than ever before. In particular, the dual set-up controls permit running two entirely different loads, alternately, or in any sequence.

AIRTRONICS Dual Preheaters bring you compact, mobile preheating POWER, plus unequalled simplicity of application, adjustment and operation. Many other unique AIRTRONICS features, such as Automatic Excitation Regulation and powerful Vacuum Cooling of the high-frequency components assure trouble-free performance under the most rigorous operating schedules.

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incorporated on the strain rods to prevent over-travel of the ram and auxiliary cylinders. Extra set of polished chrome-plated platens is used on special work.

The press for transfer molding is a 100-ton, 20 by 20 in single-opening single-ram press. The tie rods are 3 in. in diameter and designed for a maximum single opening, ram down, of 40 in. with positive stops provided to limit the ram stroke to 20 inches. The top head is adjustable step-wise from a maximum daylight, ram down, to a minimum daylight, ram down, of 30 inches. The ram closes at 48 in. per min. and presses at 7½ in. per min. at full tonnage setting. The return or opening speed is 36 in. per minute.

The 100-ton rubber press is similar to the 100-ton transfer press except that it has only a 12 in. stroke and a maximum daylight, ram down, of 24 in. that is adjustable stepwise, down to 12 inches.

The 50-ton rubber and the three 50-ton compression presses are of the same design. They are single opening, 12 by 12 in. presses. Each press is fitted with a 7 in. diameter ram having a 12 in. stroke and 2½ in. diameter tie rods provided for a maximum opening, ram down, of 24 in. that is adjustable, stepwise, down to 12 inches. Positive stops are provided to limit the stroke to 12 inches. All of the new presses have the top and moving head drilled so platens can be removed at will, molds installed complete with knockout rods, parallels, etc.

Our company has two tests that it uses to determine the amount of flow that may be obtained from its plastic materials. In the first test the sample of powder is placed in the mold and the pressure is increased directly as the time in a certain specified time to a certain specified maximum pressure. In the second test the product undergoes a set cycle before the pressure is applied. In the original molding shop the operators attempted to follow a timing indicator, that was superimposed upon the pressure gage, with the pressure indicator by controlling the pressure with a hand valve. One of the common rates used was to increase the pressure 100 p.s.i. a second, building the pressure up to 1500 p.s.i. in 15 seconds. Naturally, in an operation such as this the accuracy of the test depended wholly upon the operator and it was felt that it would be advisable to eliminate the human factor if possible. A hydraulic pump manufacturer agreed to supply an automatic pumping unit to do this job. Results have been good.

All of the plastics presses are equipped with an automatic exhaust system that is turned on for any predetermined length of time by a timer, when the press opens. Thus the exhaust operates at a time when the most gases are obtained. By having only intermittent operation, the operator is not subjected to a continual draft. The system exhausts into a dust collecting unit. The timers, that are turned on by the opening of the press, may be set for any period from 5 sec. to 2 minutes. Each press has air hose to remove work piece and dust.

One of the important items in the construction of a research laboratory or any part of one is to make proper provisions that no irritating or disturbing noises are transmitted to the point where the technical staff are working. Failure to recognize and care for this results in a considerable decrease in the efficiency of their operation. Therefore it was necessary to soundproof the ceiling of the press room and the walls and ceiling of the pump room. All foundations are isolated to prevent vibration and sound transmission.

The work of design, purchase and construction, of which only the high points have been mentioned here, was handled by the Development Engineering Division for the Chemical Engineering Division. Helpful suggestions were supplied by groups in the Laboratories and the Plastics Division at Bound Brook, New Jersey.



A QUALITY PRODUCT DEMANDS A quality display so quite naturally John B. Stetson Co. turned to plastics—acrylics and vinyls—for its first postwar counter display fixture.

Designed by company officials in cooperation with Troth & Bright, the unit takes advantage of the optical properties of the materials. The acrylic vertical support of the sign is abraded on two sides, clear on the others, and the sheet used as the base is formed so that light striking it will be piped through its edges. Fabrication is done by Croasdale & DeAngelis, Inc., with H. B. Fowler Co. silk screening the lettering on both box and black acrylic sign.

Most unique feature of the Vinylite box is the patented formed dome in the bottom. This dome, which is punctured with small circular holes to allow for air circulation, supports the hat in the cubic center of the box so that the brim maintains its curved shape.



"THE 3-CARAT DIAMOND IS NOTHING! WHAT REALLY COUNTS IS THE PLASTIC-EQUIPPED KITCHEN THAT GOES WITH IT!"

And what really counts in a molder?

We say —	
Men	Many of ours who pioneered in molded plastics have stayed on to help train our youngsters.
Equipment	Ours is modern — and we keep improving it.
Experience	We started early. We've picked up a lot of knowledge in our 25 years plus.
An Honest Way of Doing Business	This one makes a hit with most of our customers.

What do you want molded?

If it can be Molded, Boonton can Mold it

BMCO

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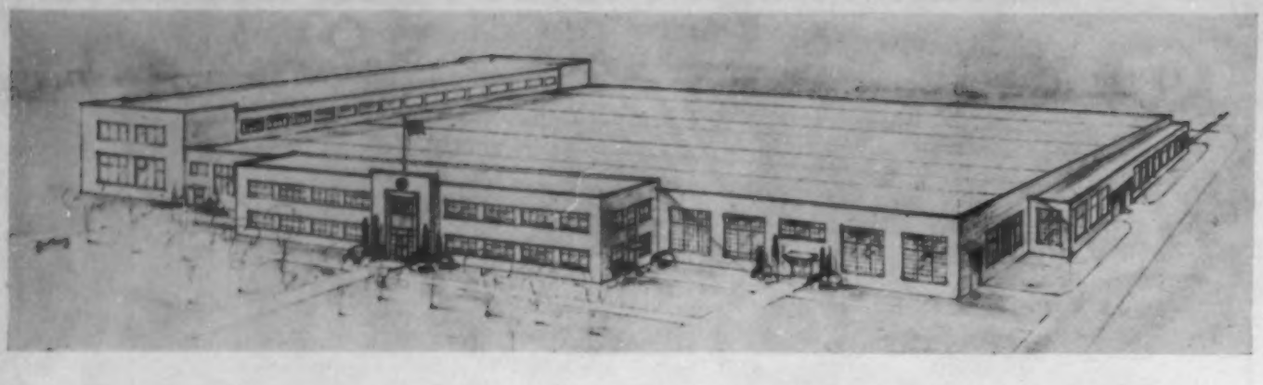
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FACTORY—BOONTON New Jersey



Here is an architect's version of this new laminated plastics plant which is now under construction

A modern laminating plant

INITIAL production in a five million dollar factory that is designed to be the largest and most modern plastics laminating plant in the country has been started by the General Electric Co., Plastics Division at Coshocton, Ohio. Although construction is by no means complete and only a few of the more than 100 presses have been installed, the first sheets of laminated material emerged from the line in August.

The new plant is replacing present General Electric facilities for manufacture of laminated materials at Lynn, Mass. It will consist of three buildings with the principal factory building comprising 235,820 sq. ft. and is expected to have an ultimate capacity of twice the present output of the company. Provisions have been made for the manufacture of both high and low pressure laminates, the fabrication of these materials, and the production of Fabroil gears.

One of the large new laminating presses, capable of turning out sheets 50 by 100 in., which is being installed

PHOTO, COURTESY GENERAL ELECTRIC CO.



The three buildings consist of the main factory structure and two smaller structures for a power plant and for the manufacture of laminating varnish. They are of modern, fireproof construction with ample ventilation and window areas. All three are one-story structures especially designed for laminated plastics manufacture. They are of steel and brick construction with inside walls consisting of attractive glazed tile blocks and gray cinder blocks. Offices will be in a two-story section in the front of the factory building while a mezzanine area in the center of the main building will house rest rooms, a dispensary, and a restaurant.

General Electric officials said that manufacturing facilities in the new plant will be modern and complete. Largest press will be a 5000 ton affair capable of producing laminated sheets 50 by 100 inches. This is believed to be as large as any available press of its kind in the country and has many added refinements. It was built by the Bethlehem Steel Company. Another giant press will form sheets 30 by 110 in. while other presses will range from 10 to 1800 tons.

One of the interesting features of the new plant is that its electric sub-station with two 5000 kva units will give the factory a greater power potential than that required by the town of Coshocton itself. The daily water consumption also is expected to rival that of the entire town.

According to G-E officials, the new five million dollar venture represents a new avowal of the faith of the General Electric Company in the future of plastics. They said that such a broad-scale operation must result not only in a wider and more diversified use of laminated plastics materials but in continued improvement in service and quality to the ultimate consumer.

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A Complete Range of Air Drills for all types of continuous production work... up to ½" capacity.



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B Model 109, aluminum housing, ¼" drill. 2500 R.P.M. Weight 2 lbs.

C Model 7027, pistol grip aircraft drill. 7000—17,000 R.P.M. Speed adjustable.

D Model 7028, button throttle aircraft drill. 7000—17,000 R.P.M. Speed adjustable.

E Model 22PDX, pistol grip throttle, ¼" and 5/16" drill. Weight 2 lbs. 9 oz.

F Model 22PDZ, pistol grip throttle, ⅜" drill. 2500 R.P.M. Weight 3 lbs.

G Model 7012, ¼" drill with No. 2 Morse Taper Head.

H Model 22BRY, right angle ¼" drill.

I Model 135, ⅜" drill. Weight 5¾ lbs.

J Model 7016, up to ½" capacity drill. Has variable position auxiliary handle. Weight 6¼ lbs.

Do your drilling faster and better with ARO Pneumatic Tools... also specify ARO for screw-driving, nut-setting, grinding, polishing, sanding, filing and other production jobs. Precision-built ... dependable. Write for literature. The Aro Equipment Corporation, Bryan, Ohio.

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Books and Booklets

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery.

Modern organic finishes, their application to industrial products

by R. H. Wampler

Published by Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y., 1946

Price $8.50 **452 pages**

The latest practical commercial methods of preparing equipment for finishing, applying organic protective and decorative finishes and drying them are reviewed in this manual. Directed to the manufacturers, the book also shows how to select, test, prepare and apply materials which produce coatings. One chapter is devoted to the method of finishing plastics and resin impregnated wood.

Organic Preparations

by Conrad Weygand

Interscience Publishers, Inc., 215 Fourth Ave., New York, 1945

Price $6.00 **534 pages**

This is a translation of a German text originally published in 1938. It provides a wealth of information on laboratory procedures for carrying out the basic reactions of organic chemistry. The systematic treatment of the subject and a comprehensive index make it a very useful reference work. G. M. K.

● The technique of contour sawing and filing is explained in "Instruction programs, DoAll machines, tools, gages, Vol. I," a 263-page book published by the DoAll Co., Minneapolis 4, Minn. Designed for use in educational and vocational institutions, the book will also be helpful to companies in trainee instruction. Conventional and high-speed sawing procedures, including work projects, tests and grading data, are covered. Quantities up to 50 are free of charge.

● "Die-less duplicating" is the subject of the Di-Acro catalog No. 46-10, just published by O'Neil-Irwin Mfg. Co., Minneapolis 15, Minn. The 40-page booklet describes the company's precision machines for the duplicating of metal parts without the use of dies and of the handwork usually necessary with intricate shapes that cannot be formed at all with dies.

● Standardized interchangeable punches and dies with all accessories are described in edition FF of a catalog issued by Richard Brothers Div., Allied Products Corp., Detroit 11, Mich. Profusely illustrated in two colors, the booklet contains, in addition to technical data and price lists, mention of company's other products—bushings, dowel pins, cap screws.

● New war-tested toxicants for insecticides, Pentalyn X and Pentalyn M-802 A for fast-kettling, quick-bodying varnishes, Plastic Peel and Cellolyn 102, a new resin for nitrocellulose lacquers are reviewed in "Hercules chemist, No. 16" by Hercules Powder Co., Wilmington 99, Del. The down-to-earth text has been enlivened with eye-catching sketches, charts and photographs.

The company has also brought out another booklet, "Hercules products," which lists its chemicals and industrial explosives along with the more than 50 industries which utilize these products.

● A comprehensive study of industrial diamond tools is offered by J. K. Smit & Sons, Inc., New York 7, N. Y., in its booklet, "Industrial Diamond Tools, Catalog T." Nineteen pages are devoted to cross-section drawings of diamond-tipped tools used for truing and dressing abrasive wheels and the type of machine in which they are used. The remainder of the booklet deals with miscellaneous standard tools such as a hand dresser, grooving tool and T-shaped dresser.

● "The story of Celanese plastics," a booklet issued by the Celanese Corp. of America, New York 16, N. Y., reviews the principal Celanese cellulosic plastics—Lumarith, Forticel, Celluloid and Vimlite. Latest uses of these plastics are shown.

● "Sundstrand hydraulic 'circuit control' pump," a bulletin offered by the Pump Div. of the Sundstrand Machine Tool Co. Rockford, Ill., illustrates and describes the operating principles, features, possible applications and engineering data for this pump.

● The Plastics Div. of the General Electric Co., Pittsfield, Mass., has just issued the annual "One Plastics Avenue" brochure. The 20-page booklet describes complete plastics facilities—research, development, design, engineering, mold-making, laminating and low-pressure molding—offered by the company.

● Dow Corning Corp., Midland, Mich., has issued a pamphlet (Resin Series No. 1) on how to use DC 996, the high temperature Silicone insulating varnish, which curves at low temperature. Application of DC 996 is illustrated in nine steps.

The company has also compiled a leaflet describing its emulsion of silicone mold release fluid designated as No. 35 and intended for use as a release agent in the molding of both synthetic and natural rubber.

● An attractively illustrated booklet giving the special characteristics and combination of properties of du Pont plastics has been published by the Plastics Department of the E. I. du Pont de Nemours & Co., Inc., Arlington, N. J. Analyzed are Lucite, Polythene, nylon, BCM, CCA, Butacite, Pyralin and Plastacele materials.

● A new handbook, "Maintenance of industrial electronic equipment" by the Westinghouse Electric Corp., Pittsburgh 30, Pa., outlines preventive maintenance techniques designed to maintain efficiency, minimize service interruptions and eliminate major breakdowns. Cleaning, inspecting, feeling, tightening, adjusting and lubricating are discussed.

● "Watson-Stillman hydraulic presses for hobbing and die sinking," Bulletin 360-A, has been released by the Watson-Stillman Co., Roselle, N. J. A full discussion of these new presses in a 200- to 3000-ton capacity range are given.

● "Films on chemical subjects—1946," compiled by William B. Lodder and Olive Noble and issued by the American Chemical Society, Washington 6, D. C., lists about 400 educational films on the chemical field and briefly describes each one. Availability of the film, location and charges are also given.

● Three new booklets have just been published by Carbide and Carbon Chemicals Corp., a unit of Union Carbide and Carbon Corp., New York 17, N. Y. One discusses the physical and chemical properties of 10 ketones produced by Carbide and Carbon Chemicals Corp. Principal uses, specifications and shipping data are given.

A 12-page booklet, "Physical properties of synthetic organic chemicals," gives the physical properties and applications for more than 175 synthetic organic chemicals in tabular form.

"Anhydrides," discusses in detail the properties and uses of acetic anhydride, propionic anhydride, butyric anhydride and maleic anhydride.

● Two styles of try-cocks, which facilitate frequent check on the water level in steam boilers, are discussed in bulletin WG-1815, issued by Yarnall-Waring Co., Philadelphia. (*Please turn to page 192*)



★

SPECIFICITY, *precise adjustment to one specific application*, is the distinguishing characteristic of Interlake Resins.

THEY are made—not to do several jobs—but to do *one job well*—and to keep on doing it *uniformly!*

They are called *specification resins* because Interlake, in each case, functionally engineers one resin to the specific requirements and conditions of *your* application—tests it on *your* job, in *your* plant—then stabilizes its production for continuous uniformity in performance.

That is why important industrial users come to Interlake when contemplating new resin applications—or—when a presently used resin is *not* fully meeting the functional and production requirements of a particular job.

The largest, the smallest and the most intricate pieces ever molded have been molded of Makalot Thermosetting Compounds.

WHATEVER properties have been required of molded materials—and, in not a few instances, properties desired *but never previously thought possible*—have been obtained by molders using Makalot Compounds.

Interlake has low loss Makalot Compounds for high frequency applications, non-cracking for molding around inserts, non-shrinking, heat resistant, general purpose, super-impact, X-ray or sweat resistant, or with brilliant surface lustre—and —*every one* of these compounds has been proved in successful use by some of the country's foremost molders.

There is a Makalot Compound for every molding job.

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Interlake will supply a Specification Resin or a Makalot Compound *exactly suited to your application*. Write Interlake Chemical Corporation, Plastics Division, 1911 Union Commerce Building, Cleveland 14, Ohio.

New Machinery and Equipment

● **Oven**—The Dispatch Oven Co., Minneapolis 14, Minn., announces the PLHD-2-5 oven for the extraction of moisture from thermoplastic materials and preheating prior to feeding into the hopper of the presses. It is automatically controlled to



provide balanced temperature and heat flow in all 10 drawers, each of which is 20- by 30- by 3½ in. Forced draft horizontal air flow is provided by use of a special high velocity fan. Three inches of insulation keep heat loss to a minimum. Capacity is provided for 100 to 700 lb. of material in an 8-hr. day. The ovens can be operated on either 110 or 220 volt current.

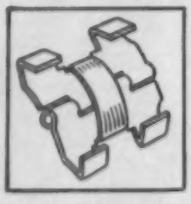
● **Surface finish measurer**—The Brush Development Co., Cleveland 14, Ohio, has introduced Model B1-103 surface analyzer for measuring surface finishes of plastics, metals, paper, etc. Finishes are checked from less than 1 to 500 micro-inches. Exploration is achieved with a fine diamond point. Instantaneous chart record provides accurate "peak and valley" profile while a 2-min. warm-up time makes instant use possible.

● **Timer**—An electronic interval timer, Model 1029, with a time range from 1 to 120 sec. in increments of 1 sec. and an accuracy of better than 5 percent, has been introduced by Electronic Controls, Inc., Newark 4, N. J. It is suitable for all applications requiring highly accurate circuit timing. Contacts are rated at 500 watts at voltages to 32 volts DC and 125 volts AC. The steel cabinet measures 6 by 6 by 6 inches.

● **Milling machine**—The Cincinnati Milling Machine Co., Cincinnati 9, Ohio, has announced a new medium-sized knee-and-column type milling machine, the No. 2 MI, powered by a 5-hp. motor and built in plain, universal and vertical styles. These machines have speed and feed ratios of 60 to 1 and 120 to 1, respectively. Sixteen spindle speeds ranging from 25 to 1500 r.p.m. and 16 feeds from ¼ to 30 in. per min. are changed with a single crank type control. "Live" rapid traverse, at the rate of 150 in. per min. longitudinal and cross, and 75 in. per min. vertical, may be engaged through a lever control at the side of the knee. Other features include: built-in electrical controls and push buttons, heavy rectangular overarm with built-in vibration damper, pull-out quick adjusting micrometer dials, one-piece bridle-type brace and unit type mounting of spindle drive gearing.

● **Hydraulic press**—A 40-ton capacity general purpose hydraulic press for short production runs, testing purposes, or for hot or cold plastic molding has been introduced by the Watson-Stillman Co., Roselle, N. J. It can be set up for light work below its capacity without damaging the work through overloading, the company claims, and the unit handles a variety of jobs that cannot be done practically on single-purpose equipment. It can be used for metal-forming, straightening or bending, hobbing, forcing. A microvalve controls pressure steplessly in ranges from 25 percent to maximum capacity. With double acting rams, punches can be withdrawn when the press is used for plastic molding or metal drawing operations.

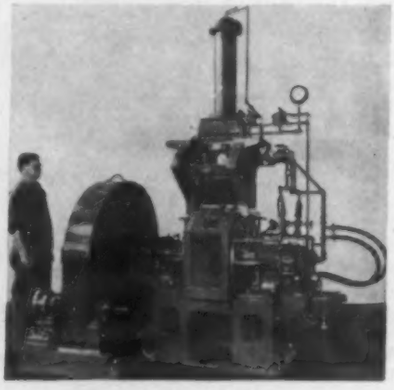
● **Friction grip spring hinge**—It has recently been brought to our attention that a friction grip spring hinge, shown in the accompanying sketch was developed several years ago by Arnett T. Bryant. This hinge was subsequently patented and the patent assigned to Norton Laboratories, Inc. Ease of assembly into molded pockets in both cover and bottom of a box is one of its major features. The projecting lugs dig into the molded material, thereby assuring a permanent assembly. Provision is made for adding a spring to this hinge which acts to hold the cover fixed in either open or closed position. The patent number on this hinge is U. S. 2,144,481.



● **Grinder**—A "Universal" high speed grinder which can be set on a bench, hung from a hook or suspended from the operator's belt has been announced by Wyzenbeek & Staff, Inc., Chicago 22, Ill. Three sizes are made for light, medium and high speed work, for grinding, burring, filing, sanding or polishing. Speed 10,000 r.p.m. Model 00-U, ¼ hp.; Model 000-U2, 1/12 hp.; Model 000-U1, 1/10 hp. Motors are the Universal AC-DC type with toggle switch in base. Handpieces are ball bearing with ⅛ and ¼ in. collets.

● **Vacuum coating**—The industrial high vacuum coating unit No. 3103, permitting low-cost mass production of plastic or glass surfaces coated with metallic or low-reflection films, is presented by the National Research Corp., Boston 15, Mass. Two 10-in. diffusion pumps with a combined capacity of 6000 C.F.M. are manifolded by a 14-in. high vacuum valve and backed by a 100-C.F.M. mechanical pump to reduce the pressure in a clear dry tank from atmospheric to 5 by 10^{-4} mm. Hg. or less. With charges of plastic pieces, it is expected to run three complete coating cycles per hour.

● **Mixer**—Farrel Birmingham Co., Inc., Ansonia, Conn., has added a small size Banbury mixer, known as 1A, to the line of F-B production units for the rubber and plastics industries. Developed originally



for mixing small batches of Neoprene stock, the 1A is, according to the company, equally adapted for other natural and synthetic rubber and plastics stocks. This mixer has a capacity of 24 lb. of crude natural rubber or the specific gravity of the stock multiplied by 24. The net volume of the mixing chamber is 1193 cu. inches.

● **Electronic heater**—An electronic heater for dielectric heating of plastic preforms has been announced by the Industrial Heating Div. of the General Electric Co., Schenectady, N. Y. It is designed for operation at 40 megacycles, using a water-cooled oscillator tube. Small enough to fit between two molding presses, the heater can accommodate their alternate operation. (*Please turn to page 208*)


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Pure Phenolic
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Solid (Powdered)
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1015—3025
8121, 3014
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Abrasive Discs
1045, 2838
Solid (Powdered)
Solid (Powdered)
Oil Modified Phenolic (Powdered)
6334, 7627, 9111
5477F, 5475
6106, 7200, 9815
Oil Soluble (Lump)
Oil Modified (70%—85% solids)
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News of the Industry

● The Tool and Die Div. of Lester Engineering Co., Cleveland 13, Ohio. has been reorganized under the name of Lester-Aetna Tool and Die Co. and moved to Warren, Ohio, where its facilities have been expanded. Aetna-Standard Engineering Co. of that city and Lester Engineering are joint owners of the new firm.

● It is called to the attention of the plastics industry that under an Executive Order signed by President Truman on June 30, 1946, "manufacturers, wholesalers and retailers and all other persons required under price control regulations to have maintained records must preserve them until July 1, 1947."

● A new casting compound called Plastiform is now being produced by Duorite Plastic Industries, Culver City, Calif. This new compound, a combination of ceramic and resinous ingredients, is prepared for casting by heating and can be reheated and recast innumerable times.

● A. Bamberger, Brooklyn 11, N. Y., has been incorporated as A. Bamberger Corp.

● Hungerford Research Corp., Murray Hill, N. J., has merged with Hungerford Plastics Corp. of that city, the new firm to retain the latter name.

● A new company to be known as B. & K. Plastic Co., 556 Summer St., Paterson, N. J., has been organized for the manufacture and sale of plastic fabrications of novelties, appliances and fixtures.

● Companies whose instrumentation requirements do not justify maintaining an instrument department of their own will benefit from a new company known as Instrumentation, Inc. and located in Cleveland 14, Ohio. It offers the following functions and facilities on intermittent, part-time or full-time arrangements: design and development, application, engineering, procurement, installation, repair, operation and maintenance.

● Hyproducts Corp., Long Island City, N. Y., has been purchased by Regal Games, Inc., of that city, according to a recent announcement. The enlarged company expects to expand its plastic products manufacturing. Richard Pederson will remain with the new owners as research and sales consultant.

● The Onsrud Cutter Mfg. Co., Libertyville, Ill., has recently been organized to produce all types of cutters required in shaping, routing and related operations.

● If any of our readers who have entered the plastics field during the past year wish to be included in the annual directory of the 1947 MODERN PLASTICS ENCYCLOPEDIA, we urge them to request a listing blank immediately. No cost or obligation is involved. Address Plastics Catalogue Corporation, 122 East 42nd St., New York 17, N. Y.

These listings include materials and chemicals, equipment and supplies, machine tools, machinery, molders, extruders, fabricators, laminators, consultants, testing laboratories, industrial designers, molders' markings and trade names.

● A new firm known as Plasticite Corp. with headquarters at 432 E. 165th St., Bronx 56, N. Y., has recently been formed to do custom injection molding.

● Alien Property Custodian James E. Markham has announced the availability of the complete files of patents seized from German and Japanese nationals. These can be found in the patent departments of the Chicago and Boston Public Libraries and at the APC's San Francisco office.

● B. F. Goodrich Co., Akron, Ohio, and Treesdale Laboratories, Inc., Pittsburgh, Pa., have made a joint announcement that the former will manufacture and sell Permaproof compounds for flame-, mildew- and water-proofing fabrics, which were developed by the Pittsburgh company.

● Completely automatic molding is graphically demonstrated in a full color 16-mm. motion picture, "Robots at work," which has been prepared by F. J. Stokes Machine Co., Philadelphia 20, Pa. Prints are loaned to engineering and industrial groups for showings.

● A step in furthering the opportunities for training of young men planning to enter the plastics industry has been taken by Polytechnic Institute of Brooklyn, Brooklyn 2, N. Y., with the addition to their chemical engineering course of four optional courses in plastics: organic chemistry of plastics, plastic technology lab., plastic technology, and plastic mold and product design. During 1946–1947 these will be offered in evening sessions only.

● Cadet Chemical Corp., Buffalo 5, N. Y., has announced that it is in commercial production of benzoyl peroxide, a chemical used extensively as a catalyst for polymerization of methyl methacrylate, vinyl type monomers, styrene and others, as well as a bleaching agent for oils, fats and waxes.

● Neoprint Products has recently been formed under the direction of T. Witonski for the decoration of plastic, glass and metal containers. Company offices are at 70 Greene St., New York, N. Y.

● Kearney & Trecker Corp., Milwaukee 14, Wis., has announced the opening of three new direct factory sales and service offices: Detroit office at 4363 Woodward Ave., Royal Oak; Cleveland office at 1426 B. F. Keith Building; Pittsburgh office at 925 Frick Building.

● Metal Plastics Products & Displays, Kenmore, N. Y., will offer fabricating services instead of model making, starting on October 1.

● John S. Barnes Corp., Rockford, Ill., manufacturers of hydraulic equipment, has appointed George M. Pearse Co., Newark 2, N. J., as its sales representative in metropolitan New York and Newark.

● Announcement has been made of the expansion of the Vyncote Div., Watson-Standard Co., Pittsburgh, Pa., in order to meet demands for its series of vinyl plastic coatings for application to metal products including aluminum and magnesium.

● G. K. M. Plastics, Inc., Paterson 3, N. J., is now operating under the name of United States Plastic Corporation.

● Casein Co. of America, Div. of Borden Co., New York 17, N. Y., has introduced to the trade a liquid urea-resin glue called Casco-Resin 135 which is craze-resistant and suited especially for edge gluing, assembly and dowel work. In these capacities it is said to serve well as replacement for currently scarce animal and casein glues.

● Resistoflex Corp. has purchased the plant which it operated in Belleville, N. J., for the purpose of continuing its manufacture of aviation and automotive hose for gasoline, oils and solvents.

● Denison Engineering Co., Columbus 16, Ohio, has made the following appointments of exclusive dealers for its Multipress and other items: Briggs-Weaver Machinery Co., Dallas 2, Tex., to cover northern Texas, New Mexico and western

Lower Tool Costs
FEWER CAVITIES

Increased Production
SHORTER CYCLE

Precision Quality
CONSOLIDATED-CONTROLLED



This handle (A, B) and socket (C) are components of a home hair-waving unit. They were plunger molded for HALGAR INC., CHICAGO.

CMP PLUNGER MOLDING *Gives You All Three!*

The handle halves (A, B) and socket (C) of this appliance were plunger molded of general purpose phenolic—in production quantities—in less time — with fewer cavities — and at less cost than conventional methods!

Plunger molding, the newer approach to faster, more economical and none-the-less precise processing, permits the molding in place of inserts [Note Threaded Insert in Socket (C)]. Elements when assembled as a unit (D), exemplify precision molding at its best!

Of prime importance is the fact that the customer is well pleased . . . his product well served. As a result of this and countless other Consolidated-solved problems, we invite the opportunity to apply our know-how to any and all custom molding assignments. Should you be planning in plastics, your inquiry will be appreciated.

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Oklahoma; Noland Co., Chattanooga 1, Tenn., to cover Alabama, Georgia and part of Tennessee; B & W Machine Co., Inc., Indianapolis, Ind., to cover southern Indiana and Western Kentucky.

● Battelle Memorial Institute, Columbus 1, Ohio, has installed enlarged chemical engineering laboratory facilities for research for industry.

● Playing a part in the elaborate centennial celebration of the city of Milwaukee, Wis., last month was the booth of Plexite Plastics Corp., of that city, which was specially constructed, using Lucite and Plexiglas, and featured articles fabricated from acrylics. Several of the smaller fabricated transparent items were manufactured behind curved acrylic show screens for spectators at the exhibit.

● Announcement has been made by Celanese Plastics Corp., New York 16, N. Y., that in order to simplify identification of its cellulosic plastics, the firm's ethyl cellulose will be known as Celcon.

● Two new materials have been developed by Resinous Products and Chemical Co., Inc., Philadelphia 5, Pa. Emulsion G-25 is a resin emulsion designed for use in plasticizing of Buna N films and the polyvinyl chloride lattices, which is characterized by non-migration, permanence, resistance to heat and hot oil, and flexibility at low temperatures. Paraplex-40 is a plasticizer to aid in the compounding of polyvinyl chloride and synthetic rubber stocks, said to be not subject to spue, migration or extraction by aliphatic solvents. The plasticizer also becomes an integral part of the composition.

● Donald L. Hadley, formerly design consultant for Westinghouse Electric Corp; Charleton B. Ryder, formerly coordinator of apparatus design for General Electric Co.; and Nicholas F. Pederson, formerly technical supervisor for General Electric Co.; have formed the firm of Hadley, Ryder & Pederson, design consultants, and will open offices in Hartford Conn., in the near future.

● A donation by MODERN PLASTICS of 52 specimens representing recent applications of 11 synthetic plastics, along with a copy of the MODERN PLASTICS CATALOG for 1945, has recently been acknowledged by Dr. F. L. Lewton, Curator of Crafts and Industries, the Smithsonian Institution, United States National Museum, Washington 25, D. C.

● The Boston office of H. K. Porter Co., Inc., Pittsburgh 22, Pa., has been moved from 38 Chauncy St. to 294 Washington St., Room 735, Boston 8, Mass.

● Available for immediate shipment are the pure phenolic resins, Arofene 700 and Arofene 775, formulated for the coating industry by U. S. Industrial Chemicals, Inc., New York 17, N. Y. According to description, both resins are entirely free from rosin and rosin derivatives and are designed primarily for use in spar varnishes, chemical-resistant finishes, ethyl cellulose finishes as well as for varnishes for fortifying alkyds.

● Two non-inflammable cements for use with methyl methacrylate, one (1S-1) a non-viscous production cement, and the other (3S-1) a viscous cement containing body, have been announced by the Crescent Engineering & Research Co., South Pasadena, California.

● American Viscose Corp., New York 1, N. Y., has announced that it has entered into agreement for the acquisition of the business and properties of Sylvania Industrial Corp., and its subsidiary, Sylvan Plastics, Inc.

● Specially formulated for use as a coolant in the sawing, drilling, grinding and machining of plastics is a new type of coolant concentrate, known as Cool-Cut X, which has been announced by Paul Swartz, New York 17, N. Y.

● The Swedish Plastics Federation has been formed recently to serve as common ground for all companies and individuals interested in plastics and related fields. It is a branch of the organization founded at the start of the war to act in an advisory capacity on questions of importing and distribution of raw materials.

● The Plastics Industries Technical Institute, with offices in Los Angeles, Chicago and New York, has announced the following curriculum: A 34-wk. Basic Plastics Technology course divided into 4 wk. of introduction to plastics, 15 wk of fabrication shop, plaster, industrial arts design, properties and chemistry of materials; and 15 wk. of molding practice and testing, molding problems, mold design and related topics. Also an 18-wk. Advanced Plastics Technology course covering shop and laboratory work, special assignments and thesis work.

● The partnership which previously operated as Valite Div. of Valentine Sugars has announced its incorporation as Valite Corp., New Orleans 6, La. Manufacture of its Valite industrial resins will continue without interruption.

● It has been disclosed that arrangements have been completed whereby Blaw-Knox Co., Pittsburgh, Pa., takes over from J. O. Ross Engineering Corp., New York, N. Y., all engineering, sales, fabricating and installation of the Ross Supertherm hot water heating system in both North and South America.

● Schwab & Frank, Inc., Detroit 7, Mich., has moved general offices and manufacturing plant to 2941 E. Warren Ave.

● Rogers Corp., Manchester, Conn., has announced that it will supply free to manufacturers production samples of sheets of new fibrous and plastic materials from as little as 25 lb. of component ingredients. The materials include cellulose, lignin, phenolics, ureas, Vinsol, flax, ground wood, cork and others. The corporation produces fibrous and plastic boards by a special beater process which makes use of wet lamination of many thin plies under high pressure without adhesives or chemicals and dried free from tension. The fibers stay interlocked after fabrication, providing extra strength to the completed parts.

● Plastics Molders Guild of New York, Inc., New York, N. Y., has been chartered by the New York Secretary of State as a membership corporation without capital stock. Directors to serve until the first annual meeting are John M. Keating, Ida Bennett and George F. Reid.

● Effective July 31, the business of the American Cyanamid and Chemical Corp., a subsidiary, was consolidated with that of the parent company, American Cyanamid Co., New York, N. Y. It will be operated as the Industrial Chemicals Div. of the company.

● Acquisition of the Plastics Industries Technical Institute of New York, Chicago and Los Angeles has been announced by Technical Crafts Corp., Los Angeles, Calif. Expansion in many fields is planned.

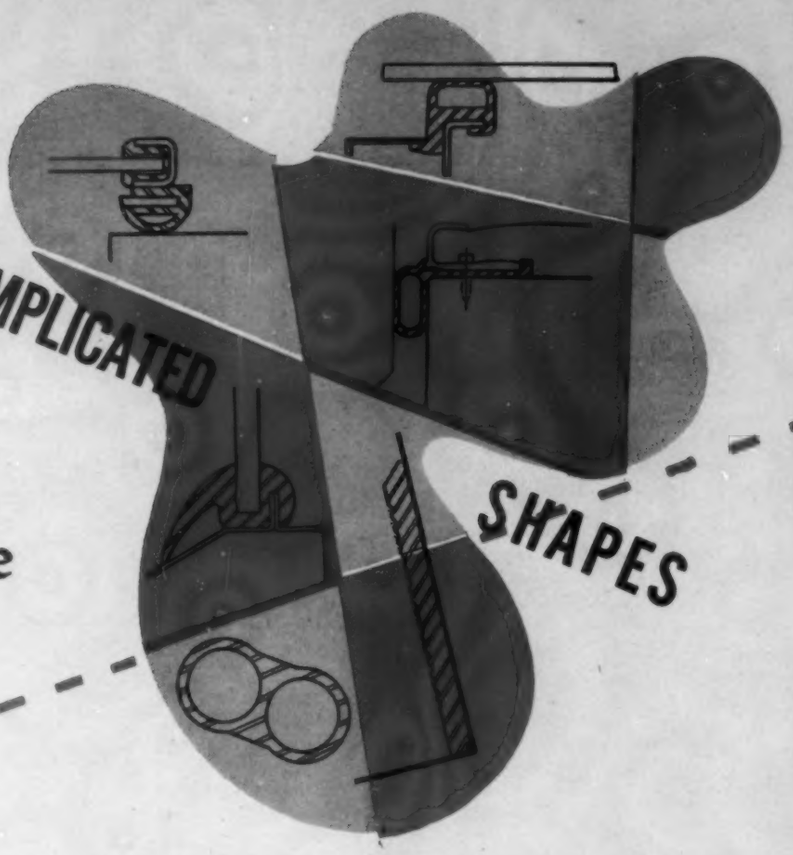
● A new firm for the sale of special equipment in process engineering has been formed by W. H. Davidson and H. E. Serner with offices in the Commercial Trust Building, Philadelphia, Pa., and at 342 Madison Ave., New York. It will specialize in solvent extraction, agitation, solvent recovery, mixing, distillation and special heat exchange process design.

● Perkins R-55 and RP-60 resorcinol and phenol-resorcinol resins, produced by Perkins Glue Co., Lansdale, Pa., are said to have broad application as waterproof, cold-setting, general-purpose adhesives, particularly qualified for timber laminating, prefabricating and assembly gluing of products which must withstand conditions of extreme exposure in any climate.

● Unexcelled Mfg. Co., Inc., New York, N. Y., has announced that, in order to describe more accurately its operations which now include the manufacture of paint and varnish, plastics, industrial finishes, wood and cordage preservatives, the company will henceforth be known as Unexcelled Chemical Corp. C. Russell MacGregor has been elected president.

● A water-repellent silicone material known as Dri-Film, which can be used to form a continuous insulating film over glass, particularly in fluorescent lamps, has

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been developed by General Electric Co., Pittsfield, Mass. The material was first used during the warfor treatment of ceramic insulators for radios, which, like the lamps, would lose their effectiveness if exposed to high humidity.

● Pennsylvania Salt Mfg. Co. of Washington has announced construction of a $1,000,000 chemical plant on the Willamette River near Portland, Ore.

Personnel changes

● Dr. William H. Aiken, formerly in the Quartermaster Corps, has been named assistant manager of the plastics and coatings department in the newly organized Chemical Products Div. of Goodyear Tire and Rubber Co., Akron, Ohio.

● International Plastic Corp., Morristown, N. J., has announced the appointment of W. T. Jones as assistant sales manager of the Paper Tape Div., Walter J. Dreves, director of finance and controller and Dr. Jan Teppema, director of laboratory operations.

● Edgar S. Thompson has joined the rubber and plastics machinery sales organization of Farrel-Birmingham Co., Inc., Ansonia, Conn.

● Brown Co., New York, N. Y., producers of cellulose and allied products, has announced the addition of Thomas L. Reiling to its Technical Service Div. staff.

● William E. Bradford will be service manager in the coordination of industrial relations activities for the Naugatuck Chemical & Synthetic Rubber Div., U. S. Rubber Co., New York, N. Y., according to a news release received.

● Richard M. Lane has recently been named sales manager of Laminated Products, for the Plastics Division of the Continental Can Company.

● At the annual meeting of the American Society for Testing Materials the following officers were elected:

Arthur W. Carpenter, B. F. Goodrich Co., president, succeeding J. R. Townsend, Bell Telephone Laboratories, Inc., who continues on the board of directors as past-president for 3 years; R. L. Templin, Aluminum Co. of America, new vice-president to serve along with Senior Vice-President T. A. Boyd of General Motors Corporation.

The new members of the board of directors are: A. G. Ashcroft, Alexander Smith & Sons Carpet Co.; A. T. Chameroy, Sears, Roebuck & Co.; J. H. Foote, Commonwealth & Southern Corp.; F. E. Richart, University of Illinois; and L. H. Winkler, Bethlehem Steel Co., Inc.

● John K. Boosahda, formerly a Lieutenant in the U. S. Navy with duties in the plastics section of the Ordnance Bureau, has joined the Northern Industrial Chemical Co. in Boston, Mass.

● New appointments in the Plastics Dept. of E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del., include Dr. Robert M. Evans and Calvin R. MacBride as assistant managers of the industrial and products divisions, respectively.

● American Insulator Corp., New Freedom, Pa., has announced the following appointments: Lloyd V. Bollinger as sales manager succeeding the late Charles P. Clifford; Barto L. Attig, assistant sales manager; George B. Harper, representative in charge of the Detroit office.

● Monsanto Chemical Co., St. Louis 4, Mo., has announced the appointment of Dr. Ralph Nickerson to the textile research department of its Merrimac Div. at Everett, Mass., and the promotion of Dr. Donald H. Powers, director of textile chemicals sales development in the Merrimac Div. to director of the division's Textile Chemical Department. Nate L. Crabtree has been named to take charge of the department's sales promotion and Sawyer Sylvester, will head the department's technical section.

● S. Leon Kaye has terminated his services with Plastics Industries, Inc., New Brunswick, N. J., effective August 1 and plans to enter the plastics business himself.

● Burton F. Stauffer has retired as president and general manager of American Anode, Inc., affiliate of B. F. Goodrich Co., after 53 years in the rubber industry. He is succeeded by Dr. Robert V. Yohe.

● The election of Dr. R. W. Harris as president of American Plastics Corp., New York 1, N. Y., has recently been announced. He is also vice president and director of Heyden Chemical Corp.

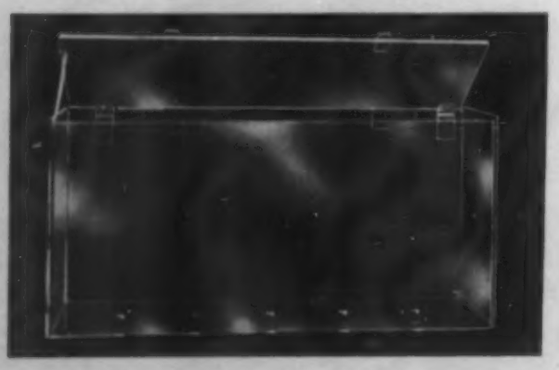
● Ian D. Patterson has been appointed to the newly created post of assistant manager of the Chemical Product Development Div., Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

● Promotions at Erie Resistor Corp., Erie, Pa., have been announced as follows: W. O. Bretschneider, manager of the new Production Engineering Dept; J. P. Murphy, superintendent of the plastics molding production and Charles Catalde, superintendent of the plastics finishing production.

Sorry!

● The plastic orchid described on page 95 of our July 1946 issue was, due to a misunderstanding, said to be distributed by Ideas Unlimited, whereas actually Bruce L. Yohe of Alhambra, Calif., is sole distributor of this article.

AN ALL-PLASTIC TRANSPARENT HINGE requiring no pins of metal or other material has been achieved by Willson Plastics Div., Willson Magazine Camera Co. in its product *hinged Plexiglas*, for which patents have been applied.



The process is a simple one of laminating Vinylite to Plexiglas, neither of the materials being affected in physical or chemical properties by the process. A thin sheet of the vinyl (0.020 to 0.12 in.) is laminated to a much thicker sheet of acrylic (1/8 in.). Then the acrylic is sawed through leaving the vinyl sheet untouched and making a hinge of the vinyl.

An adroit use of the new product was found by Amplex Plastics Corp., who utilized it for making an acrylic box for the hosiery industry. The box contains spools holding nylon thread which is fed through several orifices in the bottom.

CELLULOSICS ... LOW-COST SOLUTION TO THE HOUSING PROBLEM...



Made by A. C. Gilbert Co. from cellulose acetate and ethyl cellulose (Nixon C/A and E/C) supplied by Nixon Nitration Works

Like many other manufacturers with complex product housing problems, A. C. Gilbert Co., New York, found a simple, low-cost solution—for its new "Whirlbeater" mixer—in the cellulosics (Nixon C/A and E/C).

Major considerations were extreme light weight and compactness—combined with good mechanical and dielectric strength. All were readily achieved with the cellulosics, because they can be injection-molded into thin walls without undue sacrifice of high impact resistance and electrical properties. The attractive light gray color likewise offered no problem, since the cellulosics are unsurpassed in color range and luster.

Your products may benefit from a plastic "house". Then, consider the cellulosics for their greater economy and salability.



Cellulose acetate for tough, transparent "showcase" containers

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Books and Booklets

(Continued from page 182)

● Tube-Kote, Inc., Houston, Texas, has issued a 4-page leaflet describing tests conducted on the company's TK-2 thermosetting plastic coating which is designed to prevent corrosion of metal.

● Tinius Olsen Testing Machine Co., Philadelphia 23, Pa., has announced its Catalog 30 which covers the company's entire line of Universal testing machines for tension, compression and flexure testing. The principle and operation of the Olsen pendulum lever-weighing system, hydraulic and electromechanical loading systems and testing ranges are described.

● The 1945 Rubber Redbook, published biennially by Rubber Age, 250 W. 57th St., New York 19, N. Y., has been announced. Priced at $5.00 a copy, the directory contains one section particularly pertinent to the plastics industry on "Synthetic rubbers and other rubber-like materials," including polyvinyl resins, plasticized vinyl chloride polymers, and ethylene polymers.

● Wheelco Instruments Co., Chicago 7, Ill., has released Bulletin D4-2 announcing the company's newest development in their series of electronic temperature controls, the Multronic Capacitrol. The flexible unit uses two electronic control circuits operating in harmony with each other but independently, making for instantaneous control action.

● A new service entitled "Public Domain" has been inaugurated by Scientific Development Corp., New York 19, N. Y., in the form of a 250-page weekly publication containing over 1000 patents due to expire four weeks after date of issue. For each patent there will be a reproduction of a draftsman's drawing together with a digest of typical claims and salient features. A simplified index is included. Charter subscriptions to the service are available at $45 for one year, $25 for six months and $10 for ten weeks.

● A weekly listing of American and captured German scientific and technical information, secret during the war, is available in the "Bibliography of scientific and industrial reports," distributed by the Office of Publication Board, Department of Commerce, Washington 25, D. C. They are available in mimeograph forms or as photostats or microfilms. The Bibliography, which will be a master reference guide to at least 100,000 individual items, lists each report by subject and author along with an abstract and the price. Because the future size cannot be predicted, a subscription price has not been set. A $10 deposit to the Superintendent of Documents, Washington 25, D. C., will cover about nine months or 39 issues.

● The Special Chemicals Div. of Pennsylvania Salt Manufacturing Co., Philadelphia 7, Pa., has issued a pamphlet on the use of Pennsalt PM-90, a new acid-type chemical-cleaner for metals as in pickling tanks and heat transfer equipment.

● A protective coating for application to concrete and structural steel, to floors, pipes, tanks and machinery is the subject of a booklet published by Prufcoat Laboratories, Inc., Cambridge 42, Mass. The product is said to give positive protection against acids, alkalis, oil and water. Available in standard colors, the coating is applied by brush or spray gun and dries by evaporation.

● The enlarged 1946 edition of the special compilation of A.S.T.M. Standards on Rubber and Rubber-like Materials, recently announced by the American Society for Testing Materials, brings together in convienient form over 75 specifications and tests covering natural and synthetic rubbers. Copies of the 560-page volume can be obtained from the Society at 1916 Race St., Philadelphia 3, Pa., for $3.25 each.

● A booklet published by Lamson Corp., Syracuse 1, N. Y., counsels manufacturers and wholesalers to "Utilize the 'air rights' of your ceilings" through use of overhead chain conveyors in production rooms, stockrooms, warehouses and packing and shipping departments. The company has also issued a brochure entitled "The Lamson record of achievement in World War II."

● Airdraulics Engineering, Inc., New Canaan, Conn., has published a leaflet on the Tru-Torque beam stand used by manufacturers in the inspector's office and elsewhere, and on the True-Torque screw drivers.

● The application of colloidal graphite to the under pulley side of drive and conveyor belts as a means of controlling static electricity developed on these conveyor belts is the subject of a technical bulletin prepared by Acheson Colloids Corp., Port Huron, Michigan.

● Catalog No. 46, prepared by George F. Marchant Co., Chicago, Ill., describes the firm's punches, dies, couplings, rivet sets and other tools. Over 200 sketches are employed to illustrate the equipment.

● Ampco Metal, Inc., Milwaukee 4, Wis., has issued Catalog 117 on its line of safety tools which are designed for use in the presence of explosive liquids, fumes, gases and dust. The company has also released Bulletin 66 on the machining of Ampco Metal and Bulletin 81 on Ampcoloy 90 for high conductivity copper castings which are available to those manufacturers who are specifically interested in these two subjects.

COMBINING THE OPTICAL AND LIGHT transmission qualities of acrylic materials with the vigorous color qualities of nitrocellulose sheet,



Willson Plastics Div., Willson Magazine Camera Co., has developed a new laminate on which a patent is pending and which will be known as Kolorplast.

The Celluloid sheets in irridescent pearl tones, in "bread pudding" effects and in translucent colors are laminated to thicker sheets of Plexiglas and delivered to fabricators who use the laminates in making powder boxes, cigarette cases, hand mirror backs, bathroom accessories and other items. Temperature and pressures used are a secret of the manufacturing process.

The makers state that exhaustive tests indicate that the adhesion is sufficiently strong for all purposes to which the material would be put, and that in fabrication, tools normally used on the acrylics are quite satisfactory for this new synthetic as well.

IN THE METALWORKING INDUSTRIES

The Magazine Edited for the Men Who Decide:





Which Material

(WHOSE MATERIAL)

Laminated Plastics or Powder Metal Parts?

What Method

(WHOSE EQUIPMENT)

Inspection by Fixed Gage or Adjustable Gage?





MATERIALS & METHODS

THE METALWORKING INDUSTRIES' ENGINEERING MAGAZINE

Metals and Alloys

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New section for S.P.E.

Organization of the Western New England Section of the Society of Plastics Engineers was completed at a business meeting July 29th at the Hotel Sheraton, Springfield, Mass. Mario Petretti, general manager of the Plastics Division, Noma Electric Company, was named president.

Other officers named include Frank J. Donohue, Monsanto Chemical Company's Plastic Division, vice-president; George W. Carlson, Arrow-Hart & Hegeman, treasurer; John Bitter, Parker Stamp Works, secretary. Directors include Henry M. Richardson, DeBell & Richardson; E. G. Gray, General Electric Company; W. L. Larson, Modern Design; T. C. Roberts, LaPointe Plascomold; and E. S. Ellingham, Wico Electric Company.

The newly formed Western New England section is intended to embrace Vermont, New Hampshire, Western Massachusetts, and Northern Connecticut.

Plans were made for a meeting to be held September 24 in Springfield when officers of the national Society will address the group and various discussions on technical aspects of plastics will be held.

Honeycomb core structure

(*Continued from page 135*) aluminum alloy 24ST on standard core with $^{7}/_{16}$ in. cell size. a decrease in efficiency of the faces is noted for gages 0.016 in. and less.

The second type, often referred to as *wrinkling failure*, arises from the fact that the skins are plates on elastic foundations and are therefore subject to instability in themselves. Although this type of failure has been experienced in several column tests, all indications are that it will only occur at very high stresses.

Table VI.—Typical Short Column Test Results on Honeycomb Core Structures

Specimen no.	*Thickness of face*	*Thickness*	*Width*	*Column length*	*Ultimate load*	*Stress in faces*
	in.	*in.*	*in.*	*in.*	*lb.*	*p.s.i.*
2753–4	0.0165	0.946	2.98	9.93	3,910	39,700
" –5		0.946	3.01	5.83	4,000	40,300
2781–3	24ST Alclad	0.981	3.03	9.85	3,650	39,800
" –4		0.992	2.98	6.00	3,950	43,700
2754–4	0.032	0.975	3.05	9.96	9,340	45,700
" –5		0.976	3.02	6.02	9,040	44,600
2780–3	24ST Alclad	1.018	3.07	9.91	8,760	42,100
" –4		1.007	3.01	5.99	8,900	46,300
2755–4	0.0315	0.971	3.00	9.60	10,750	56,800
" –5		0.972	2.92	6.10	10,940	59,500
2782–3	75ST Alclad	1.015	3.00	10.00	10,770	57,100
" –4		1.024	3.00	6.02	11,760	62,300

The results of several short column tests are given in Table VI and typical examples of both types of local failure in Fig. 5. Generally, ultimate stresses for 0.016-in. 24ST Alclad faces are lower than for 0.032-in. 24ST Alclad faces, because the 0.016 in. faces buckled into the cells while all the others were wrinkling failures.

Design details

In the application of honeycomb core structures it has been found that the fabrication of individual panels into finished products introduces some unique problems not experienced in other types of structural materials. In most cases, the problems can be attributed to the extremely low density of the core and the very thin faces. Both of these facts make it necessary to locally reinforce the core and improve the bearing area of the sandwich at points where structural attachments are to be made. Some of the common methods of accomplishing this are described below.

In most cases high density inserts and edge banding molded into the panels are desirable. The materials commonly used are wood, plastic, aluminum extrusions and even solid aluminum. Several typical details are shown in Fig. 12. This practice requires that the points needing local re-enforcement are established before the panel is made.

As an alternative, a spacer bushing made of an aluminum alloy was designed for use on panels where attachment points could not be predetermined. It is a general-purpose fitting in that it can be inserted at any point in the panel and will transfer loads in the plane of the plate as well as normal to the plate. There are several variations of the same general idea that can be used. Two of them are shown in Fig. 14. Our tests indicate that maximum strength is attained by bonding these fittings into panel with Plycozite adhesive.

Manufacturing processes

As industry returns to a competitive state, individual companies are reluctant to disclose manufacturing processes which have been developed at considerable expenditure of time and money. In the case of honeycomb core structures a good share of the development expense has been incurred in finding out how not to do things. While that education is still going on, certain clear-cut procedures are taking shape.

The honeycomb core may be cured on a corrugating drum in the form of a continuous corrugation. These sheets are cut to length, indexed and assembled into block form—making in effect a honeycomb log. The *log* is sliced on a band saw into sheet form for panel assemblies.

By another method, honeycomb core may be made by (in effect) strip gluing to a pattern single sheets of material which are then assembled in a stack for curing in a press. The cured solid blocks are cut into strips which are expanded, Christmas-bell fashion, to make honeycomb core sheet. The expanded honeycomb is sprayed or dipped in a resin bath, air dried and cured in an oven. The technique may be varied somewhat


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depending upon the material and resin which are used in making the core.

The process from there on is typical of any good panel assembly operation. Care must, however, be taken that the right amount of the assembly adhesive is properly distributed on the honeycomb core. While the process sounds simple, it has been determined that careful attention to many small but important details is necessary to insure well-bonded panels.

Much development work remains to be completed, particularly in the design of production machinery for low-cost honeycomb, but enough work has been done that the possibilities of the material may be visualized. Even now, where some premium can be paid for weight saved in structural panels, honeycomb core constructions are proving their worth.

Applications for honeycomb panels

The most natural application for honeycomb core structures and one where weight is extremely important because its value can easily be computed, is in aircraft. Many of the new planes and some reconversions will have flooring made with honeycomb faced with either plywood or aluminum alloy skins. In one installation a 35 percent saving in weight with a 30 percent increase in strength was effected. The service life of this floor is expected to be several times that of the floor it replaces. Honeycomb panels for partitions, doors, shelving, table tops, work surfaces with thin stainless steel skins, air ducts and other structure where the stiffness-weight ratio determines design are rapidly being engineered and installed in these planes.

As more service data is obtained it is not too far fetched to imagine that entire fuselage sections may economically be fabricated with honeycomb constructions. In fact in the Glenn L. Martin Company Model 202, Twin-Engine Transport plane the honeycomb sandwich flooring is designed to take primary loads as part of the fuselage structure.

Honeycomb constructions are also finding a place in other forms of transportation. While it is too early to disclose specific applications it is noted that through economies in fabrication and because of the value of the weight saved, honeycomb panels are being used in industrial trailers, railroad passenger cars and house trailers.

Suggested industrial uses for these light-weight panels are outrunning our capacity to develop since in most manufacturing operations there is some application where weight and stiffness are critical. To date prototypes have been engineered for air freight shipping containers, cold storage shipping containers, scaffolding, lightweight furniture, partitions, trays for handling semifinished work between processes and many confidential projects.

Manufacture of phenolic compounds

(*Continued from page 162*) ping containers through another screen which corresponds in mesh size to the required particle size. The containers are carefully sealed so that the material will not absorb moisture and thus deteriorate electrically. Store in a dry place.

Trolitan type 31 series 4600

The molding compound is prepared by either the kneading-rolling or mixing-rolling process as described for Trolitan Type 31 Series 1400. The processing conditions are given in Table II. The material taken from the rolls is ground to pass a 2.5-mm. mesh screen.

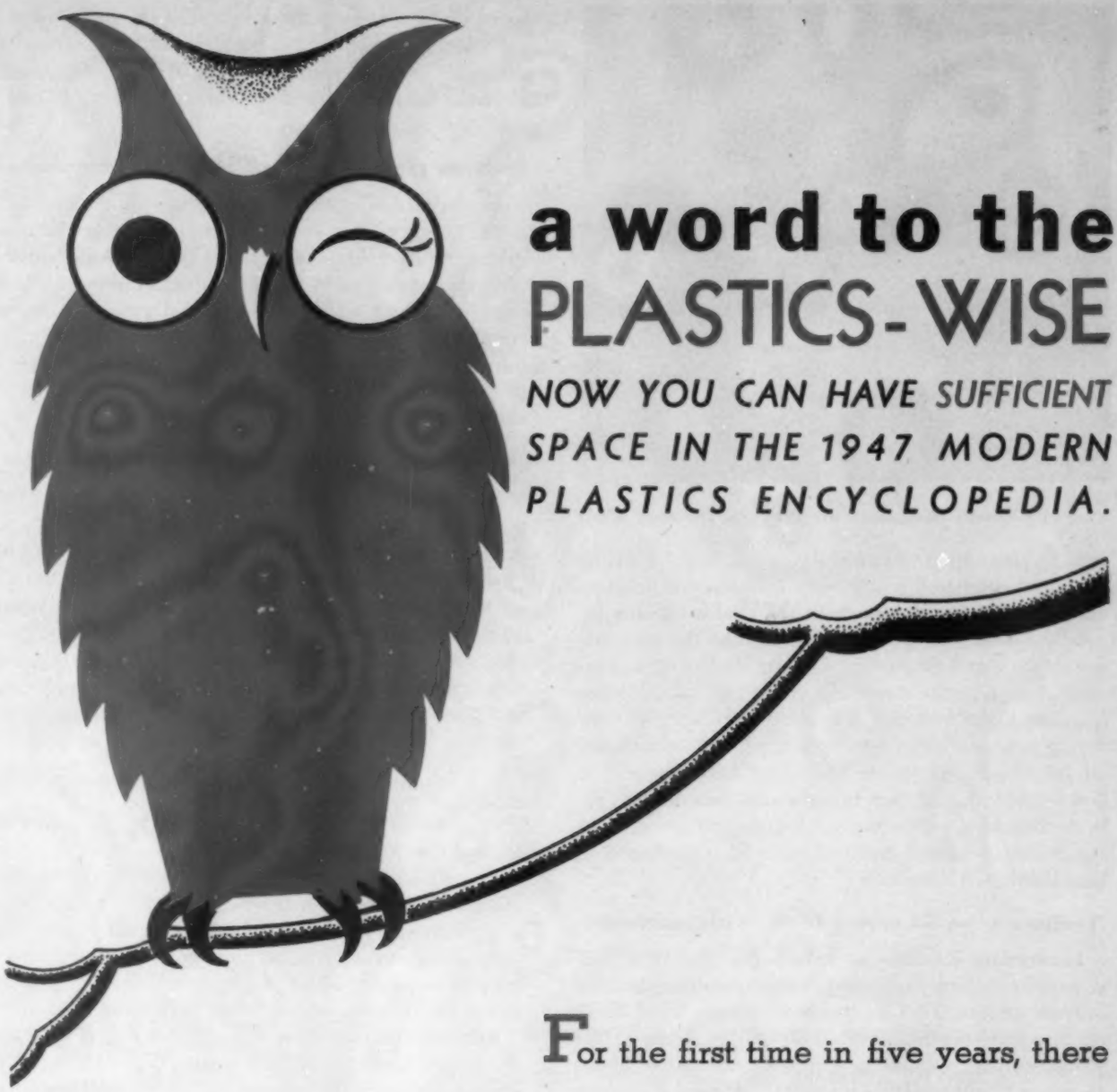
Trolitan type 41 series 1109

Approximately one-third of the woodflour mixture is added to the kneader, then the resin and, subsequently, the rest of the woodflour with the hexamethylenetetramine, magnesium oxide, magnesium stearate and 4 percent of water based on the wet composition. Kneading and rolling are done under the conditions shown in Table II. The rolls are adjusted as close as possible. The rolled material is broken into small pieces by hand and ground to pass a 3-mm. mesh screen. After grinding the material is uniformly mixed in a ball mill of 4000-liter capacity in quantities of 1600 kg. and packaged in bags.

Trolitan type 51 series 1500

Preparation of the resin solution—Grind the resin and hexamethylenetetramine to pass a 4-mm. mesh screen. If black material is being made, the coloring material and magnesium stearate are rolled into the unground resin at about 35° C. and subsequently ground as described above. Heat the alcohol to 70° C., add the coloring material and magnesium stearate and dissolve or disperse at 70° C. Then add the resin and hexamethylenetetramine and dissolve by stirring at 70° C. for 25 minutes. As mentioned previously, if black is used the coloring material and magnesium stearate are added with the resin. Magnesium oxide, previously dispersed in water, is added after 15 min., except that for black materials no magnesium oxide is added. Pass the resin solution through a 0.5-mm. mesh screen to remove undissolved particles and foreign substances. Black resin solution will be somewhat viscous. The hot resin solution is not allowed to stand unnecessarily because it will become more viscous and hence result in poorly impregnated material and resin segregation.

Preparation of the molding compound—The soda pulp is ground to a flock in the small Burma vacuum grinder to pass an enlarged screen. One-third of the flock is placed in a Werner and Pfleiderer mixer and the water is added with the blades turning outwardly. The remaining two-thirds of the flock is slowly added and the moistened soda pulp is worked for 75 minutes. Every 15 min. the blades are run inwardly for 2 min. to pre-



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View of phenolic compouud mixer at the Troisdorf plant

vent the formation of lumps in the material. Add the previously prepared warm resin solution and impregnate the pulp for 90 min. with the blades running inwardly. Every 20 min. the blades must be run outwardly for 2 min. to prevent the formation of unimpregnated lumps in the material. After the impregnation is finished, the material is removed into very shallow drying pans and dried on a rack dryer with circulating air for 3½ hr. at 90–100° C. The dried material is first broken up and then mixed in batches of 1000 kg. in the blender for 20 minutes. Lumps and foreign substances are removed and the material is packaged in bags holding 50 kilograms.

Trolitan type 54 series 1500 (with ammonia)

Impregnate Kaemmerer soda paper No. 1850 (350 g./m.²) by dipping on the vertical impregnating machine in resin solution T4/LTx (made with resin T4 of 70–80 cp. viscosity) containing chalk so that a coating of 80–90 percent, corresponding to a resin content of about 45 percent, will result. Dry at 110° C. and a running speed of 2.5 meters per minute. The finished product has a loss on drying of 3–5 percent. Cut into strips 20 cm. wide on the Verny cutter and then into small pieces on the Burberg cross-beater mill to pass a 10-mm. mesh screen.

Trolitan type 57 series 1300 (little ammonia)

Impregnate Kaemmerer soda paper No. 1850 (350 g./m.²) by dipping on the vertical impregnating machine in resin solution T1/LTx so that a coating of 55–60 percent, corresponding to a resin content of about 35 percent, will result. Dry at 100–110° C. and a running speed of 2.75 meters per minute. After drying, the impregnated paper is rolled up; it has a loss on drying of 4–6 percent. The paper is cut into desired sheet sizes on the Verny cutter.

Trolitan type 57 series 1400 (with ammonia)

Impregnate Kaemmerer soda paper No. 1850 (350 g./m.²) by dipping on the vertical impregnating machine in resin solution T4/LTx (made with resin T4 of 70–80 cp. viscosity) containing chalk so that a coating of 70–80 percent, corresponding to a resin content of 40 percent, will result. Dry at 100–110°C. and a running speed of 2.5 meters per minute. After drying, the impregnated paper is rolled up; it has a loss on drying of 3–5 percent. As final step cut the paper on the Verny cutter.

Trolitan type 71 series 1500

Preparation of the resin solution—The procedure is the same as for Trolitan Type 51 Series 1500.

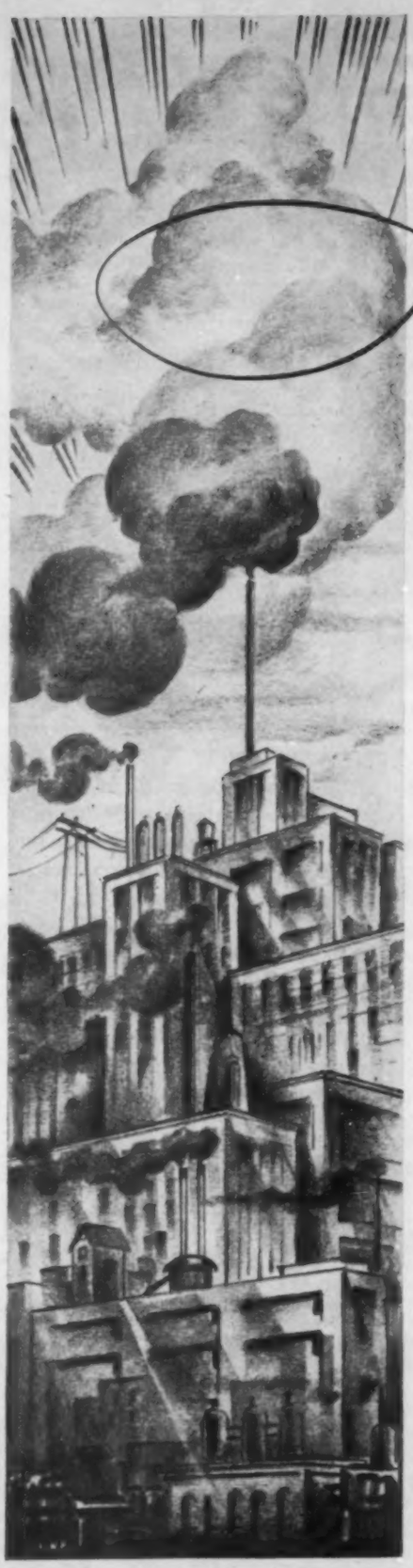
Preparation of the molding compound—Break up the macerated fabric and remove iron particles with a magnet. Very small clippings, size 00, are used. Grind the pulp sheets to a flock on the small Burma vacuum grinder to pass a 4-mm. mesh screen; for light colors sulfite pulp is used, for black and dark colors soda pulp.

Add one-third of the ground pulp together with the water and macerated fabric to the Werner and Pfleiderer mixer, pour the hot resin solution over it and mix;

Left—An edge runner mill for mixing fabric-filled molding compounds. Runner wheels rotate in one direction, pan in the other. Side and bottom scrapers and a vertical center baffle plate assist in mixing. Material is discharged through center opening in the pan. Right—Interior view of the mixer







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add slowly the remaining two-thirds of the pulp. Mix for 1½ hr. with the blades running alternately 15 min. inwardly and 15 min. outwardly in the closed mixer. The wet mixture is spread on a screen for drying.

Trolitan type 74 series 1500

Preparation of the resin solution—Procedure is the same as for Trolitan Type 51 Series 1500, except that the water is added to the kettle after the coloring material and magnesium stearate. In the case of colorless material the water is added to kettle with the alcohol.

Preparation of the molding compound—Break up the macerated fabric and remove iron particles with a magnet. Macerated fabric of size 2 is used unless otherwise stated. Add the macerated fabric to the Eirich mixer, pour the resin solution over it and mix thoroughly for 15 minutes. After the first minute remove the rods with compressed air and let the machine run briefly in reverse gear. After mixing, place the material in shallow drying pans which hold about 4 kg. (dry weight). Inspect for unimpregnated macerated fabric as the drying pans are filled.

The resin solution must not be poured into the Eirich mixer as long as a drying pan is under it. There is the danger that the resin solution might run into the pan, thus causing accumulation of resin which will form lumps during the drying process. Vacuum dry for 8½ hr. at 90° C. and 50–70 mm. of mercury pressure or in the Simplex dryer for 80–100 min. at 100–105° C. After drying, run through the shredder and mix 1000 kg. quantities in the blender for 20 min., remove large pieces of fabric, lumps and foreign substances and package in bags of 50 kg. each. The large pieces and lumps are broken up in the Excelsior grinder and reused.

Special compound B

Preparation of mix No. 1—The liquid resin is kneaded cold for 2 min. with hexamethylenetetramine, magnesium oxide and magnesium stearate; in order to prevent the liquid resin from flowing out of the kneader, a small amount of the wood fiber is added at the same time. After 2 min., the remaining wood fibers, previously pulled apart, are added over a period of 10–15 min. and the kneading continued for 20 minutes. At the beginning of the addition of the wood fibers, the steam valve is opened so that by the time the kneading is finished the temperature has gradually risen to 70° C. The material is transferred to open pans, broken by hand into small pieces and stored in closed containers.

Preparation of mix No. 2—Grind the resin and hexamethylenetetramine to pass a 4-mm. mesh screen. Mix with the calcium fluoride and other components for 1 hr. in a ball mill without balls.

Preparation of the molding compound—Add 1.3 kg. of mix No. 1 to the roller, then 15 kg. of mix No. 2, followed by 2.6 kg. of mix No. 1. Roll under the conditions shown in Table II. The materal runs on the rear roll. The rolled material is cooled, broken up in a mechanical breaker and then ground in the Excelsior grinder to particles of 6–8 mm. The ground material is mixed for 20 min. in batches of about 5000 kilograms. The blended material is passed through a 10-mm. mesh screen into shipping containers. The mold closing time is determined for every fourth rolling and the particle size at the beginning of each new batch. The properties of the molding material and molded specimens are shown in Table III.

Table III.—Specifications for Special Phenolic Molding Compounds Used for German Fuse Parts

	Compound B	*Compound N*
MOLDING COMPOUND		
Apparent density, g./liter	900 ± 100	900 ± 100
Particle size		
Less than 0.5 mm., max., percent	30	30
More than 5.0 mm.	None	None
Ash, percent	50 ± 2	44 ± 3
Water content, max., percent	1	1.8
Mold closing time, sec.	7 ± 2	7 ± 2
Shrinkage, percent	0.42 ± 0.08	0.45 ± 0.08
MOLDED MATERIAL		
Specific gravity	1.83 ± 0.02	1.77 ± 0.03
Flexural strength, kg./cm.²	>500	>600
Impact strength, unnotched, cm.-kg./cm.²	>3.5	>4.0
Impact strength, notched, cm.-kg./cm.²	>1.8	>1.7

Special compound N

Grind the resin and hexamethylenetetramine to pass a 1-mm. mesh screen. Mix with the bronzite (an iron-aluminum silicate), woodflour, magnesium stearate and magnesium oxide in a Werner and Pfleiderer mixer for 30 minutes. Roll under the conditions shown in Table II. The material runs on the rear roll. The rolled material is cooled, broken into pieces about as big as a hand and ground on the Excelsior grinder to 3-mm. particle size. The material is uniformly mixed in batches of 1000 kilograms. The blended material is passed through a 3-mm. mesh screen into paper bags. The properties of the molding material and molded specimens are shown in Table III.



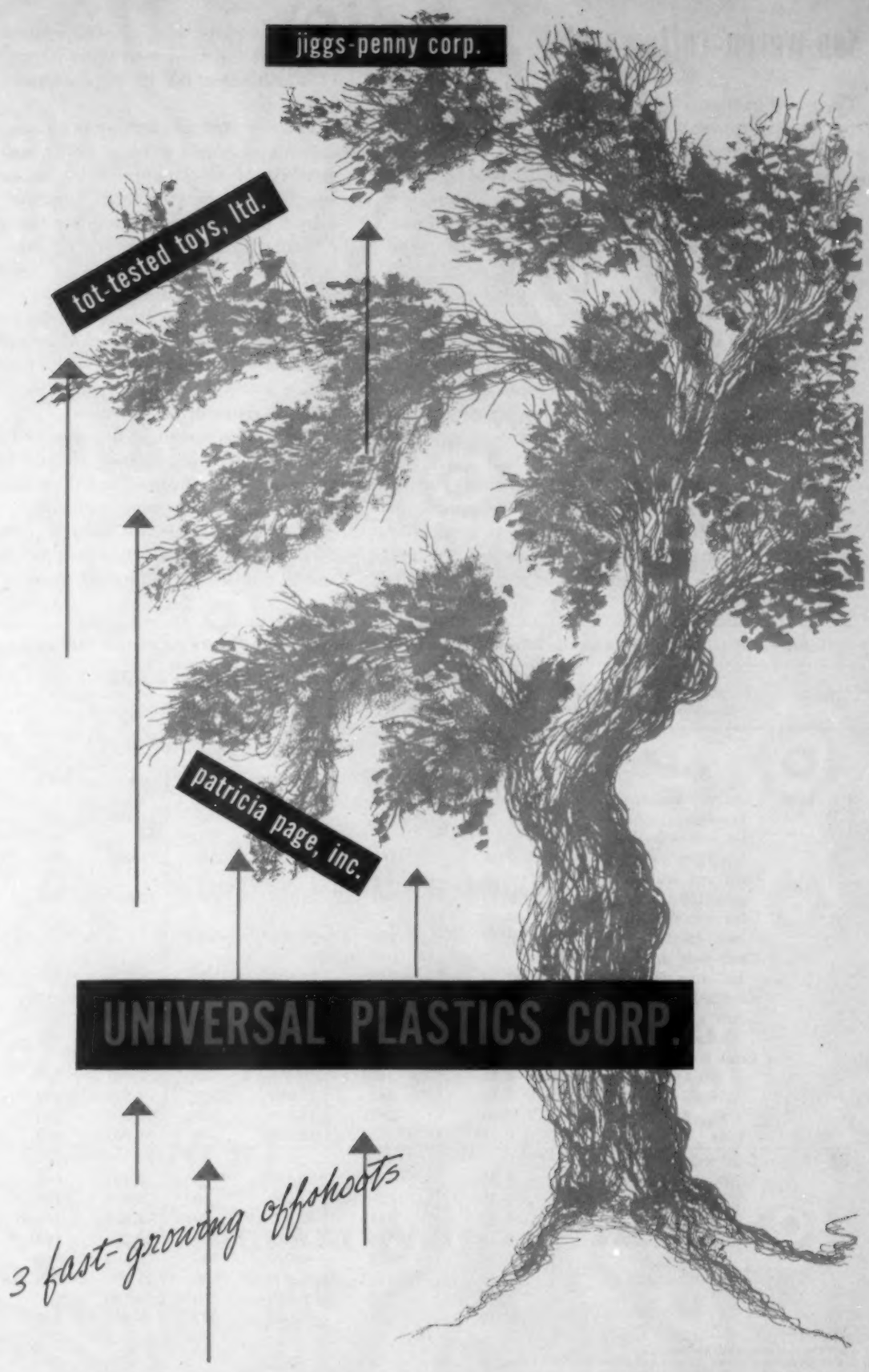
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Non-woven cotton webs

(*Continued from page 158*) orientation in the individual webs tended to result in an increase in laminate tensile strength. The increase in fiber orientation, as explained under processing methods, was brought about by drawing the webs in the with-grain direction. Thus, the fibers increased their parallel alignment from undrawn to once-drawn to twice-drawn webs. The anomalous results obtained with the 1/8- and 1/8-in. cottons was due to some process difficulties encountered in drawing these particular webs.

4. Flexural strength and modulus of elasticity in flexure appeared to be independent of staple length and staple orientation with the exception of the 1/8-in. cotton which yielded low results. No logical explanation for these data has been evolved up to the present time.

5. Impact strength data were extremely erratic and yielded no definite indications of any specific influence of the web variations studied. It is of interest to note that, in general, the flatwise impact strengths were high. This again would appear to be determined by the resin type used, since reference to Table VI indicates that the same web types impregnated with BV-1112 rather than BV-16526 gave impact results of much lower values.

Table V contains further comparisons between undrawn and drawn webs as well as effects of different methods of stacking prior to pressing and of web weight. The best balanced laminate resulted from a 2 by 2 cross-ply, which was the reason for using this construction for all laminates in Table IV. The data on effect of various web weights are meager; it does seem evident that the lighter webs give the better results. This is in agreement with the generally accepted opinion that lighter fabrics yield stronger laminates. A more thorough penetration by the resin during impregnation would seem to be a simple explanation of such a result in either of the two cases.

Table VI summarizes the results of a brief survey of the effects of using different resins. It is obvious that the use of a specific resin and the selection of particular variations in processing techniques can modify the properties of laminates over a considerable range. Since the state of the art in the formulation, choice and use of the various laminating resins is relatively unde-

Table V.—Preliminary Data on the Effect of Fiber Orientation and Web Weight on Tensile Strength and Elongation[a]

Resin	*Fiber orientation*	*Wt. of web*[b]	*Resin add-on*	*Tensile strength*[c]				*Elongation*	
				With-grain		*Cross-grain*			
				Value	*Standard error*	*Value*	*Standard error*	*With-grain*	*Cross-grain*
		grains/sq. in.	*percent*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*p.s.i.*	*percent*	*percent*
BV-16526	Card web undrawn; not cross-plied	0.48	161	10,700	100	12,600	400	2.5	2.6
	Card web undrawn; cross plied (90°)	0.48	161	13,400	200	14,400	200	0.6	0.9
	Card web undrawn; not cross-plied	0.48	161	10,700	100	12,600	400	2.5	2.6
	Card web undrawn; not cross-plied	0.32	108	20,800	500	...	...	1.9	...
	Card web drawn once,[d] not cross-plied	0.19	242	23,100	1100	4,900	700	1.7	0.2
	Card web drawn once								
	Alternate plies at 45°	0.19	242	10,800	600	11,800	200	1.3	1.3
	Alternate plies at 90°	0.19	242	15,720	1200	14,200	600	1.2	1.2
	Cross laminated[e]								
	A. 1 ply by 2 plies	0.19	242	20,400	700	7,700	700	2.1	1.0
	B. 1 ply by 4 plies	0.19	242	17,800	700	7,300	700	1.6	1.0
	C. 2 plies by 2 plies	0.19	242	13,000	800	13,650	300	1.2	1.2
	D. 4 plies by 4 plies	0.19	242	15,000	800	11,700	900	1.7	1.2
BV-17018	Card web drawn once:								
	Not cross-plied	0.19	125	20,400	1400	3,400	500	1.6	1.6
		0.19	225	17,000	600	3,000	100	2.0	0.3
		0.19	311	12,400	600	2,800	100	1.9	0.9
	Alternate plies at 45°	0.19	225	9,000	100	10,200	100	2.5	1.9
		0.19	311	4,800	700	9,300	700	2.3	2.4
	Cross-plied at 90°	0.19	125	13,400	600	15,300	600	2.0	2.3
		0.19	222	10,200	400	10,700	600	2.3	2.3
		0.19	311	8,900	600	7,000	800	2.3	2.3

[a] Data on preparation of samples:
Press conditions: 250 p.s.i. at 305–310° F. for 6 min.
Cotton studied: M. W. 1 1/8-in. Bobshaw No. 1.
[b] All samples made with 30 plies.
[c] Average of five breaks on Scott Tester.
[d] Average thickness for 30 ply drawn web samples is 0.030 in. Heavier webs make slightly thicker samples at 250 p.s.i. See Table I for effect of sample thickness above 0.030 in. on tensile strength.
[e] With-grain direction refers to the 2- and 4-ply layer.

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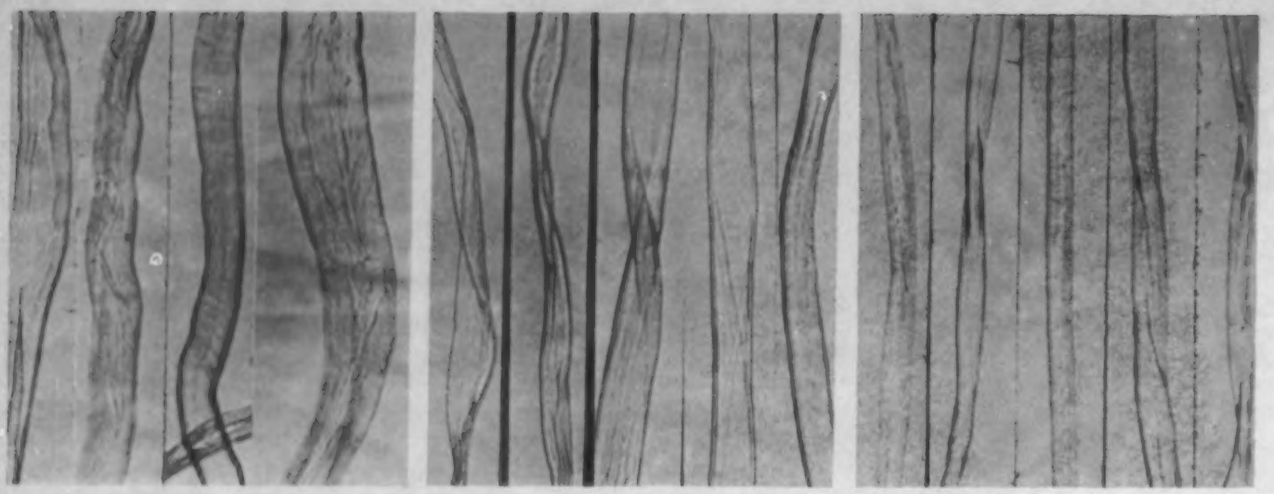
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5—*Longitudinal views of cottons of different fineness (times 252)*

veloped, no further comment will be made concerning Table VI, except to note that it was included as an expression of the recognition of the importance of the resin in the results obtained.

Discussion of Results

On the basis of the data shown in Tables IV, V and VI, it would seem that staple length and orientation have a definite influence on the strength properties of web-base laminates. However, it seems well to emphasize that the isolation of length alone from associated fiber properties is an over-simplification of the problem of evaluating the influence of web properties on laminate properties. The data being reported should only be considered as but the first step in a preliminary survey which would define the relative significance of

Table VI.—Effect of Different Resins on Properties of Web-Base Laminates[a]

Property	*BV-16526[b]* *Undrawn web*	*BV-16526[b]* *Drawn once*	*BV-1112,[b] Drawn once*	*Melmac 402,[b] Drawn once*	*Monsanto phenol formaldehyde,[c] Drawn once*	*BV-17018,[c] Drawn once*	*BV-16238,[c] Drawn once*	*BV-7929,[c] Drawn once*	*Cardelite,[c] Drawn once*
Resin add-on, percent	74	67	100	120	128	...	...	...	...
Volatiles, percent	5.9	8.3	...	...	...	...	...	...	...
Density	1.25	1.31	1.23	1.30	...	...	...	...	...
Water absorption, percent	13.1	9.0	2.1	5.4	...	...	...	...	...
Thickness change, percent	+0.6	−0.8	−1.0	−4.5	...	...	...	...	...
Tensile strength									
With-grain, p.s.i.	17,900	19,800	22,180	21,040	29,300	14,350	16,200	13,260	12,450
45° to grain, p.s.i.	16,235	...	19,320	16,560	...	...	...	...	...
Elongation at break									
With-grain, percent	3.3	...	3.8	1.5	3.5	2.2	3.4	3.0	3.9
45° to grain, percent	4.7	...	4.7	2.2	...	...	...	...	...
Flexural strength, p.s.i.	20,235	24,740	28,020	26,990	...	...	...	...	...
Modulus of elasticity in flexure, p.s.i.	898,900	1,209,500	1,231,000	1,372,000	...	...	...	...	...
Izod impact strength									
Flatwise, ft. lb./in. notch	16.38	22.13	5.73	7.53	...	...	...	...	...
Edgewise, ft. lb./in. notch	3.26	3.72	1.70	1.65	...	...	...	...	...
Bonding strength, lb.	935	680	1417	1483	...	...	...	...	...
Power factor									
At 1 mc, Condition B	0.0498	...	0.0423	0.0388	...	...	...	...	...
At 1 kc, Condition B	0.0096	...	0.0238	0.0161	...	...	...	...	...
At 1 mc, Condition D	0.4640	...	0.1310	0.1210	...	...	...	...	...
At 1 kc, Condition D	[d]	...	...	...	...	...	...	...	...
Dielectric constant									
At 1 mc, Condition B	4.27	...	4.47	4.48	...	...	...	...	...
At 1 kc, Condition B	4.56	...	4.86	4.77	...	...	...	...	...
At 1 mc, Condition D	10.60	...	5.34	5.66	...	...	...	...	...
At 1 kc, Condition D	[d]	...	...	...	...	...	...	...	...

[a] All samples made from M. W. 1½-in. Bobshaw No. 1 cotton web, 2 by 2 cross-plied at 90°.
[b] Samples approximately 0.125 in. thick. Pressed at 1100–1200 p.s.i. 130 plies of 20 grain/sq. in. web. Tensile tests on Dillon Tester.
[c] Samples approximately 0.030 in. thick. Pressed at 250 p.s.i. 30 plies of 20 grain/sq. in. web. Tensile tests on Scott Tester.
[d] Too poor to measure.



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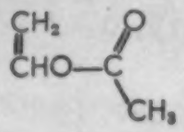
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all of the associated fiber properties that are present.

Besides the average length, two other properties of cotton fibers used to characterize them are strength and fineness (or diameter). In commercial cottons these properties vary with length as follows: the cottons with the longer fibers are usually of finer diameters and stronger tensile strengths (per unit cross-section area). Therefore, it is impossible to vary only one of the three properties in an experiment, since choosing a cotton of different length necessitates taking whatever strength and fineness it has.

The strengths of the seven cottons used were measured on a Pressley fiber tester and are tabulated in Table VII in comparison with the average lengths.

Table VII.—Fiber Length Versus Tensile Strength as Measured by the Pressley Fiber Tester[a]

Fiber length, average	*Pressley index[b]*
in.	
1/2	6.7
13/16	6.9
7/8	7.8
1	8.0
1 1/8	7.8
1 1/4	8.0
1 9/16	8.9

[a] The Pressley tester breaks a uniform bundle of fibers; the index expresses strength per unit cross-sectional area.
[b] Differences of less than 0.5 index are not significant.

It may be noted that the over-all fiber strength increase is of about the same order of magnitude as the laminate strength increase. There would seem to be some question, therefore, as to whether it is the length or it is the strength that is the determining fiber property.

By way of illustration of the amount of variation to be expected in fiber fineness, Figs. 4 and 5 have been included. The figures serve to emphasize the non-uniform character of fiber *diameter*. It is obvious that these twisted, flattened ribbons will behave quite differently from smooth cylinders when used in web form. The effect of the fiber size and shape on the laminate properties is further complicated by the fact that it cannot be divorced from the fiber length and strength.

Web-base laminates appear to have interesting potentialities, and it is hoped that the data presented in this report, while meager, will be sufficiently provocative to stimulate further work and focus attention on some phases of the problem that should be investigated further.

Acknowledgment

The efforts of many people went into the work represented by the foregoing data. Acknowledgment is herewith made for supervision in the first part of the work by Dr. W. H. Tonn, Jr.; to Mr. John R. Lyman for collection of much of the data and operation of the machines involved; and to Mr. Angus Pearson for the electrical measurements.

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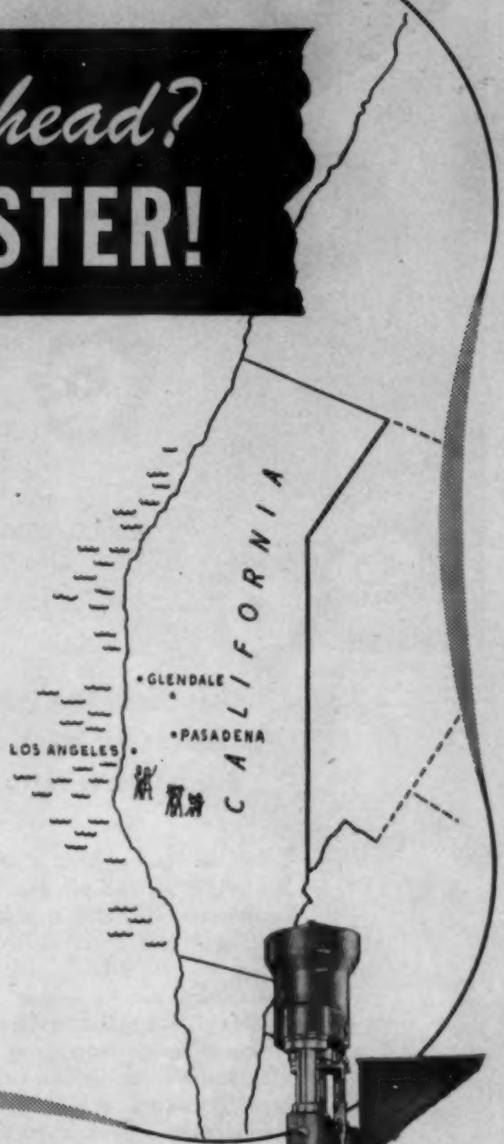
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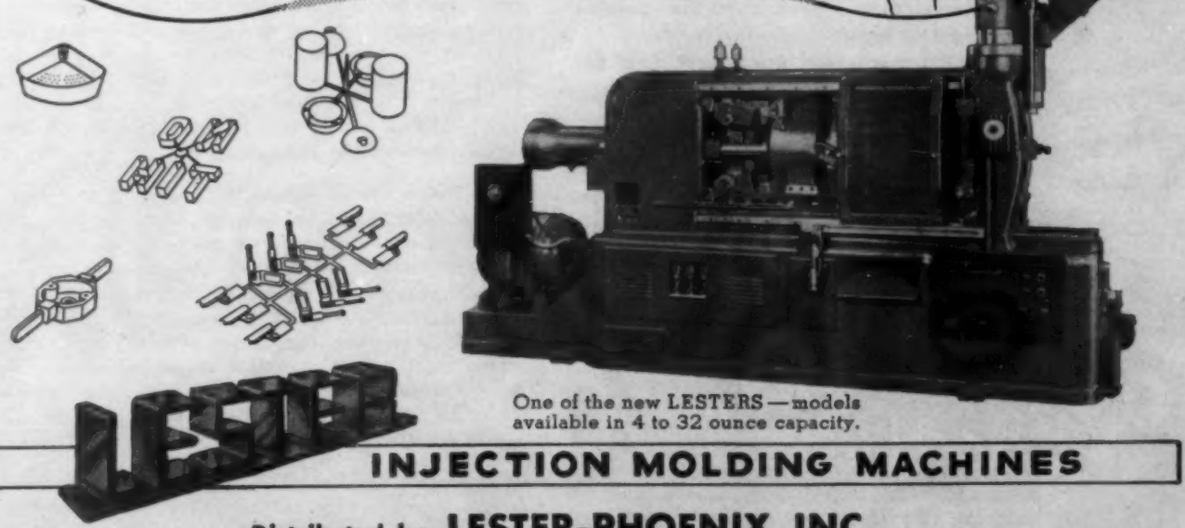
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Color is an elusive thing indeed. Scarlets, blues and pink shades will not be the same day after day unless utmost care, skill and exact weighing are adhered to. A million plastic parts are not turned out in a day nor in one batching or color blending operation. It takes many operations. To meet specifications for uniform colors requires highly accurate scales, with fraction-ounce dials. Remember the personal element differs from day to day . . . . sound mechanical equipment does not. Color achievement in plastics today is more than ever a matter of equipment. An EXACT WEIGHT Scale correctly fitted to the operation is the equipment you need for uniform color from the first mold to the last no matter how large the order. Write for full details today.

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Exact Weight Scales

THE EXACT WEIGHT SCALE COMPANY

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Dept. AC, 783 Yonge St. Toronto, Canada

New machinery and equipment

(Continued from page 184)

● **Air gun**—A *safe* air gun, the Guardair, has been announced by Algonquin Parts, Inc., South Norwalk, Conn. An airguard, located above the nozzle of the air gun, provides a safety umbrella of air to protect the worker against chips, filings, oil, etc., ejected by the air gun. These ejected particles are arrested by the force of air emitted by the guard and plummeted downward. Guardair is available with both standard nozzle and with extended tip for deep hole drilling operations.

● **Material handling unit**—A three-in-one unit combining automatic material handling with storage and transporting is being manufactured by American Machine & Foundry Co., New York 17, N. Y. This new self-leveling material handling system can be used in modern plants for machine operations, progressive assembly, storage and transporting of materials. An operator takes material to be processed from a tray in material rack at his left and places processed material in the rack at his right. A calibrated swing mechanism maintains the racks constantly at convenient working level. The filled rack can be rolled away and stored.

● **Recorder-controller**—A fully automatic recorder-controller for temperature and pressure in the manufacture of plastics, rubber, chemicals and textiles is being offered by the C. J. Tagliabue Div., Portable Products Corp., Brooklyn 5, N. Y. By use of an adjustable cam, timing starts automatically when the temperature reaches the processing point and is terminated at desired moment. A red light glows during steam-heating phase, a white light when steam has been shut off and no light when cycle is completed.

● **Platen press**—R. D. Wood Co., Philadelphia 5, Pa., has introduced a multiple-opening platen press which can be operated at pressures up to 1,500 p.s.i. Side slabs are locked to the top platen and cylinder casting by keyed joints and bolts. Platens can be either steam or electrically heated in this press 30 by 30 by 2 inches. Machined guide blocks slide on machined vertical guides attached to each side slab's inner face. The intermediate platens are guided at each corner on machined steel guide strips and are spaced with 4 in. daylight between each platen when press is in open position.

● **Light belt grinder attachment**—A light, narrow belt grinder attachment, type N-2, has been added by the Porter-Cable Machine Co., Syracuse, N. Y., to its line of abrasive belt grinders. It can be used on composition and plastic materials, steel, iron, aluminum, wood and glass for light grinding of flats, arcs, angles, gear burring, weld grinding, cleaning up operations. The unit, which can be attached to bench type wheel grinder, is 27 in. high with a width of $2^1/_2$ inches. Platen size for flat grinding is 2 by 4 inches. By using an endless abrasive belt 2 by 48 in., it can be used in the vertical, horizontal or any position between the 90 degrees.

● **Dielectric heater**—Raytherm, a new dielectric heater for use in such fields as plastics, ceramics, textiles, rubber, paper and wood, has been announced by the Industrial Electronics Div. of Raytheon Manufacturing Co., Waltham, Mass. It can be used for preheating, setting and seam bonding of thermoplastic films. Model D5G is 5 ft. $11^5/_8$ in. high, 2 ft. 4 in. wide and 3 ft. $10^7/_8$ in. long, constructed of heavy-gaged sheet metal ribbed on a welded, structural shape framework. Maximum KVA demand from a 230 or 460 volt, 3 phase 60 cycle line is 13.3. Each unit is complete with meters, cycle timer, interlocks, safety switch and control circuits for push-button operation.

● **Industrial printer**—A Markomatic industrial printer, which will find a use in shipping departments, has been introduced by Adolph Gottscho, Inc., New York 13, N. Y. It may mark up to 6 by 9 in. or 5 by 13 inches. Its production is from 300 cases per hour and up.

(Please turn to next page)

THE RAYTHEON RAYTHERM DIELECTRIC HEATER



IS READY FOR YOU, NOW!

Get the facts and figures on RAYTHERM and why it will give you better results at lower cost. Ask us to mail you Bulletin DL-H-504.

Here is a heating unit, backed by all the "know-how" and resources of Raytheon's unsurpassed electronic engineering staff, that calls for your careful consideration before you invest a single penny in preheating, laminating or seam bonding equipment.

Raytheon engineers stand ready to give you immediate and competent counsel on any or all opportunities for saving time and money with dielectric heat.

Anyone can operate the RAYTHERM



You simply push a button to start the heat, rotate one knob until the indicator reaches the red line on the dial and push the stop button when the heating time is up, or let the automatic timer do it for you. That's all there is to it.

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RAYTHEON MANUFACTURING COMPANY

Industrial Electronics Division, Waltham 54, Massachusetts

Builders of Precipitrons for electronic air cleaning, Synchronous Controls for Resistance Welding, and other Electronic Products for Industry.

Excellence in Electronics

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The Statue of Athena, highest example of Greek art, was sculptured by Phidias. This Greek goddess of wisdom, made of ivory and gold, stood in Athens, Greece. Many manufacturers of new and old products are using wisdom in considering plastics. Be wise and choose Nosco, successful molders of plastics, to help you attain a product advantage.

One of a series covering Wonders of the World. Can you name some of the others? Watch Nosco's next ad.

NOSCO IS QUALIFIED AND CAN HELP YOU. WRITE TODAY

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DIVISION OF
NATIONAL ORGAN SUPPLY CO. • ERIE, PA.

COTTON DUCKS
FOR
LAMINATED PLASTICS

Curran & Barry

ESTABLISHED 1903

320 BROADWAY NEW YORK 7, N. Y.

● **Portable pyrometer and kit**—Wheelco Instruments Co., Chicago, Ill., has introduced a new extension type portable pyrometer designed to permit a choice of plug-in angle extensions where a number of applications necessitate a universal instrument for measuring and checking temperatures requiring the use of different kind of thermocouples. Automatic compensation is a standard feature. Plug-in extensions are available in either straight, 45 or 90° angle types while adapters permit the choice of material and calibration of thermocouples. A $3^9/_{16}$ in. reflector scale prevents parallax errors in reading. Dual Iron Constantan scales are calibrated from 0 to 600° F. or 0 to 1000° F. and dual Chromel-Alumel scales are calibrated from 0 to 1600° F. or 0 to 2500° F. Both scales can be calibrated with centigrade equivalents. Meter movement consists of baked, processed coils which are supported by two lapped pivots resting in two sapphire resilient jewels. According to the company an Alnico #5 magnet provides increased ruggedness without loss of sensitivity. The pyrometer comes in a sealed aluminum case with a "pistol grip" handle which may be locked in horozontal or vertical position.

The company has also announced a portable pyrometer kit, Model 2863, containing a pyrometer, a straight type extension with adapter for Iron-Constantan surface thermocouple and an assortment of thermocouples.

● **Micrometer**—Four re-designed models of electronic micrometers for precise thickness measurement in the shop or laboratory have been introduced by the Carson Micrometer Corp., Newark 2, N. J. The electronic circuit is used in conjunction with the micrometer screw thread. Measurements to 0.00005 in. can be obtained independent of operator skill. Units are portable and weigh 20 pounds. Model L can be used for inspection, sorting, grading and measurement of machined parts, ball bearings, radio tube grids, small assemblies and depth of counterbore. Model M is for measuring diameter and out-of-round condition of fine, soft-annealed wire while Model W is for pressureless measurement against conducting surfaces. For production testing of tension and compression springs, set testing of diaphragms and metal bellow, flat springs and thermostatic elements, the company developed Model S.

● **Specialty tools**—Special tools for mold makers, tools not used often but which save time and money if they are available when needed, are the concern of Invincible Tool Co., Pittsburgh 22, Pa. This company invites an expression of the needs and desires of mold makers in this regard so that they may add to their line of heads and attachments which already includes Nos. 580 and 3125 adapters and heads for Bridgeport and Gorton vertical milling machines, No. 3125 angle heads for flexible shafts and rotary files and burrs, and Nos. 1 to 5 heavy duty angle tool attachments for mounting molds and repairs.

● **Portable test-kit**—The Miskella Infra Red Co., Cleveland 4, Ohio, presents the new portable Miskella infra test-kit, adjustable for tests and demonstrations. Wired for 115 volts it operates on either AC or DC and supplies temperatures from 70 to 400° F. Heat units are insulated and either clear or reflector lamps may be used. Standard equipment includes two superheat insulated heat units $8^1/_4$ by $10^1/_4$ by 8 in., four 250 watt infra-red reflector lamps sealed in vacuum, a set shelf and heat unit adjustments for varying distances.

● **Stationary tachometers**—The Herman H. Sticht Co., Inc., New York 7, N. Y., has introduced new stationary tachometers with 8, 10 and 20 in. dials which are designed for heavy duty and to give readability from a distance. Of the centrifugal type, these stationary tachometers are built into a water tight brass case and are flexible shaft driven. They can be furnished to read r.p.m., f.p.m., y.p.m., sheets per min., impressions per min. or per hr., or any other special operations. They are not affected by temperature variations, non-magnetic and operate in either direction of rotation.

RACINE HYDRAULIC POWER



COURTESY
MOLINE TOOL CO.
MOLINE, ILL.

automatically drilling 180 holes in fifteen strokes

Again Racine oil hydraulic Pumps, control and feed Valves, have solved a special problem. The Moline Tool Company machine shown above, drills 180 holes in a large ring with 15 hydraulically actuated strokes of 12 drill heads. The cycle is completely automatic.

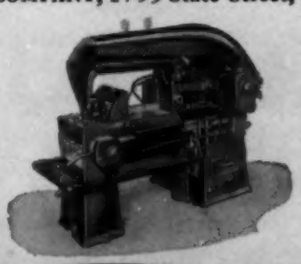
One central, Variable Volume Racine Pump supplies the hydraulic force. Indexing of the work, feeding of the drills, locating and operating cylinders are all Racine powered, and controlled with Racine Valves.

The variable volume feature of Racine Pumps extends their application to a wide range of work. Racine field and factory engineers can help you utilize the advantages of this equipment in your product. Power for bending, holding, pressing, feeding, embossing and scores of other requirements can be hydraulically applied at low cost.

Racine Variable Volume Pumps are available in capacities up to 30 G.P.M. All pressure ranges to 1000 lbs. p.s.i. Racine Hydraulic Valves in all sizes from $\frac{3}{8}$" to $1\frac{1}{2}$" I.P.S. Get interesting and complete catalog P-10-C. Write today. RACINE TOOL AND MACHINE COMPANY, 1759 State Street, Racine, Wisconsin.

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Racine's complete saw line includes models in every price range for either general shop or high speed production metal cutting. Sizes 6" x 6" to 20" x 20". Several models, featuring hydraulic operation for fast, easy and accurate cutting of any metal. Simple controls — easy to use. Write for Catalog No. 12.



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Flexo Joints will provide you with a dependable swing pipe joint that has the flexibility of hose and yet—the strength of pipe. Gives a full range of easy movements up to 360°. Wherever a swing joint is needed to convey steam, air, water, oil, or other liquids, install Flexo Joints. Comes in 4 styles and is made of 4 simple parts. Pipe sizes range from ¼" to 3". Write for detailed information.

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Branch of the Industry	Name of Appliance	Use
Molders (Thermo-plastic) Injection	VIBRA-VEYOR (Variable heat)	To preheat plastic powder automatically. To dry plastic powder automatically granule by granule
Molders (Thermo-setting) Compression	PELLET-VEYOR (Variable heat)	To preheat pellets and preforms at the press as needed
Injection	HOPPER-HEATER (Variable heat)	To warm up heavy metal of hopper of molding machine
Molders (Thermo-plastic) Extrusion	STRIP-HEATER (Variable heat)	To preheat strip rolls of vinylite, etc., automatically as fed to worm
Material Manufacturers	Special production equipment including vibrators, conveyors, stainless steel belts and electronic devices	To process various kinds of plastic material in bulk quantities
Fabricators (Miscellaneous)	BENCH-KIT In various sizes (Variable heat)	To soften sheets, rods, tubes and shapes for bending, forming, punching, etc. This includes Cellulose, Acetate, Methyl Methacrylate and Bakelite

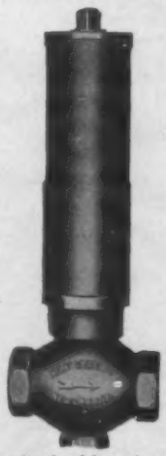
(The time on most of the operations mentioned above averages five minutes)

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ATLAS Type "E" High Pressure Reducing Valve

Those high pressures are easy for this valve which handles them *without shock*—oil, water, or air. We show the valve at the left. This is the valve that all of the leading plastics plant operators use for their high pressure work.

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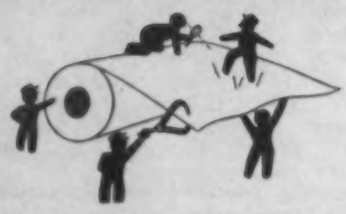
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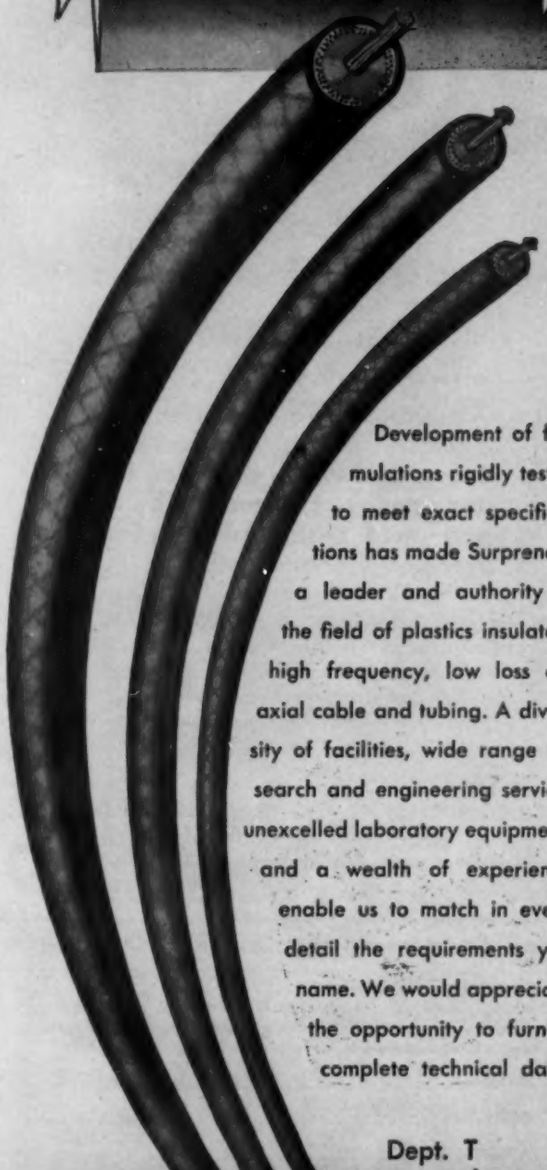
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(P-2)

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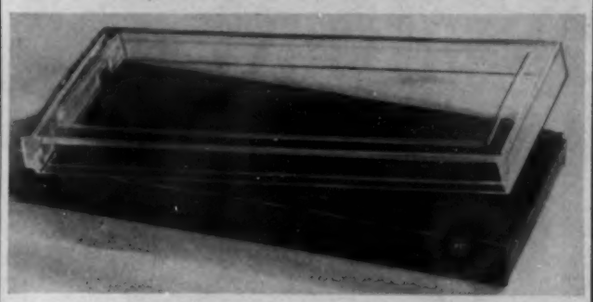
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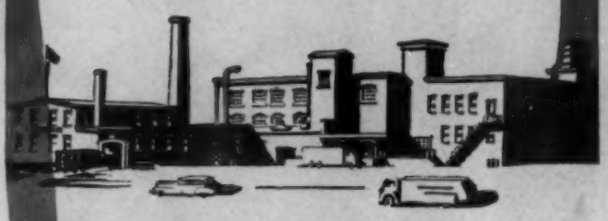
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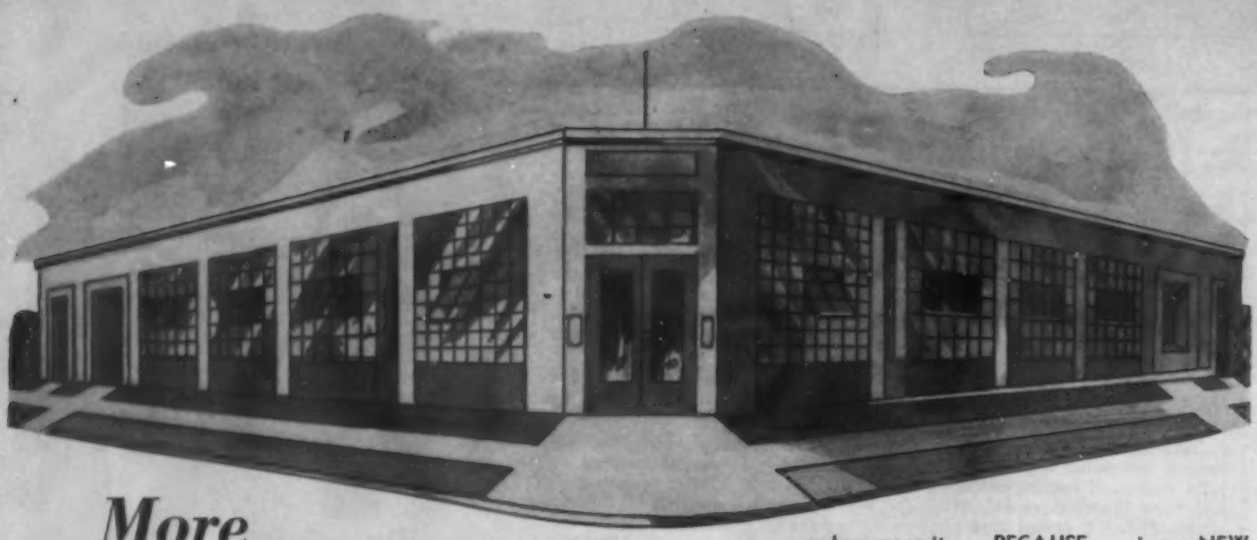
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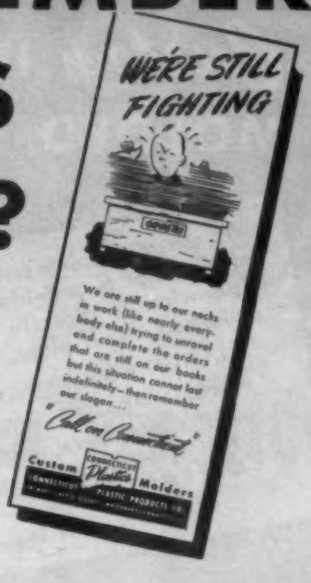
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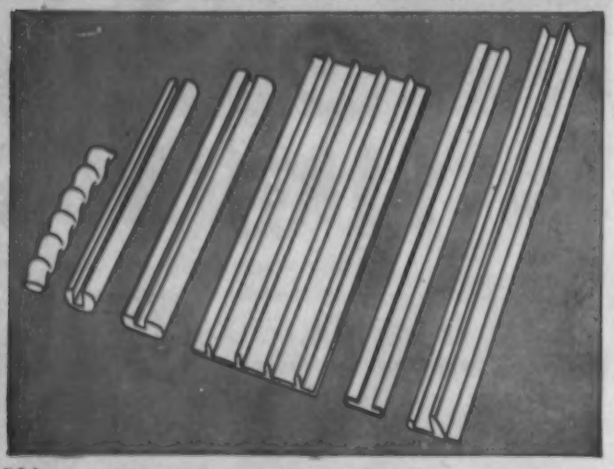
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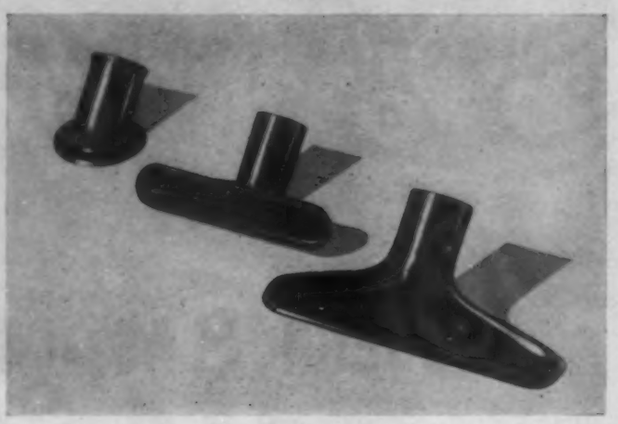
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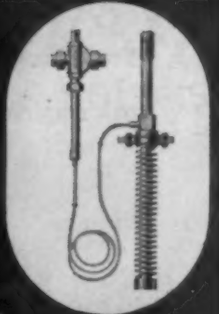
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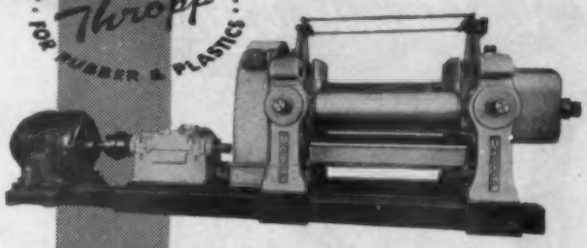
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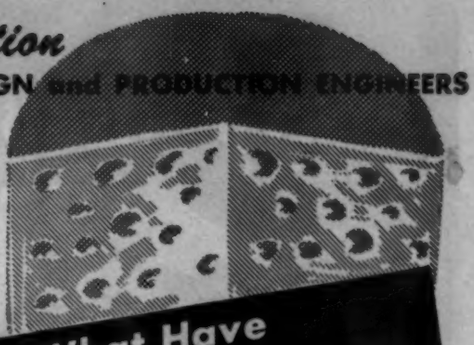
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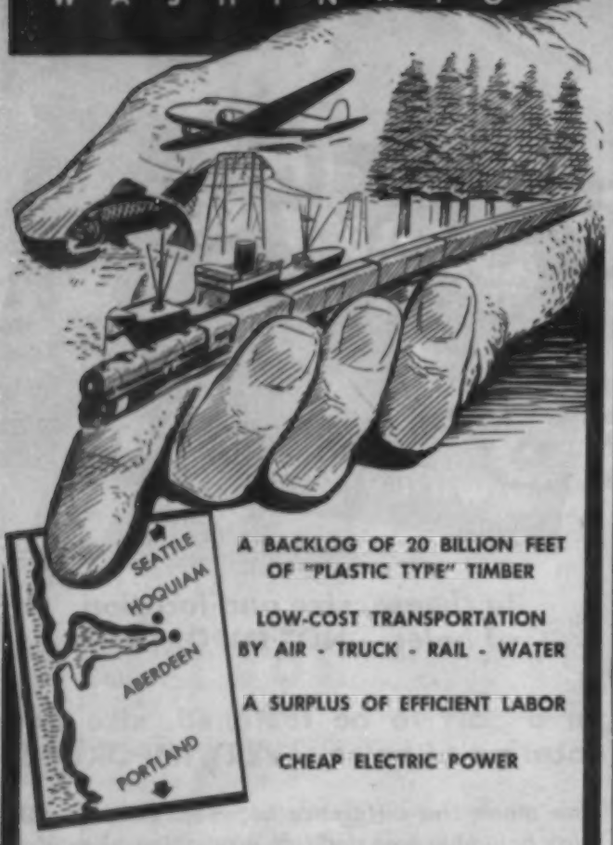
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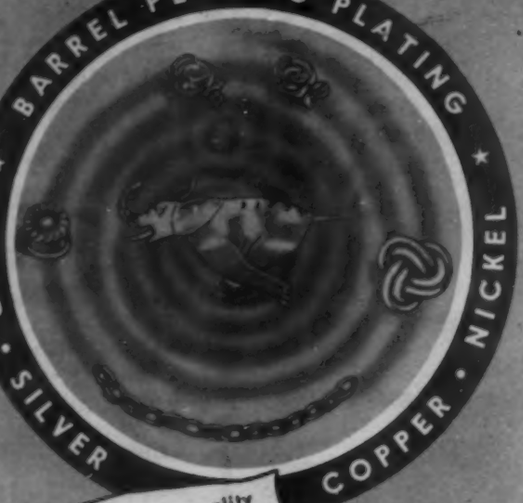
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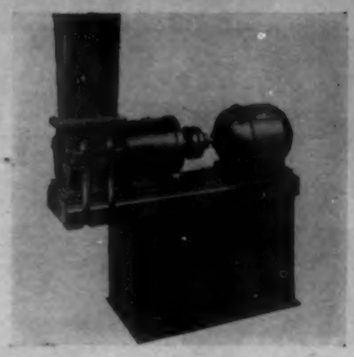


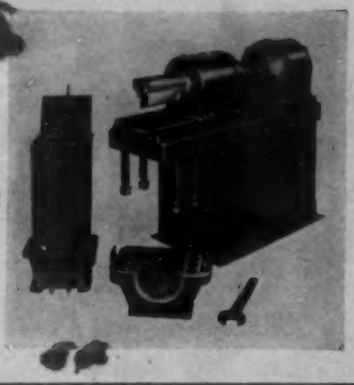
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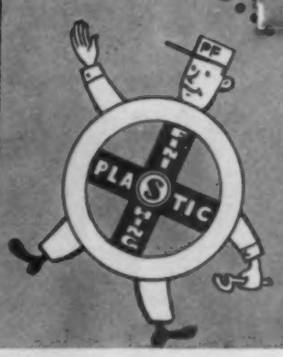
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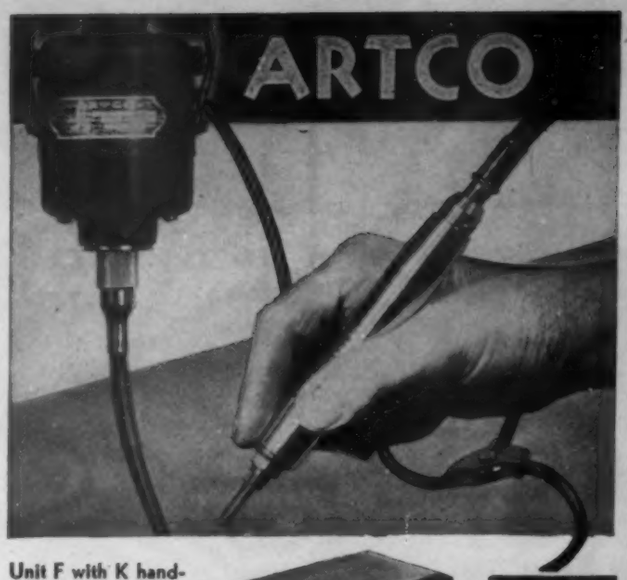
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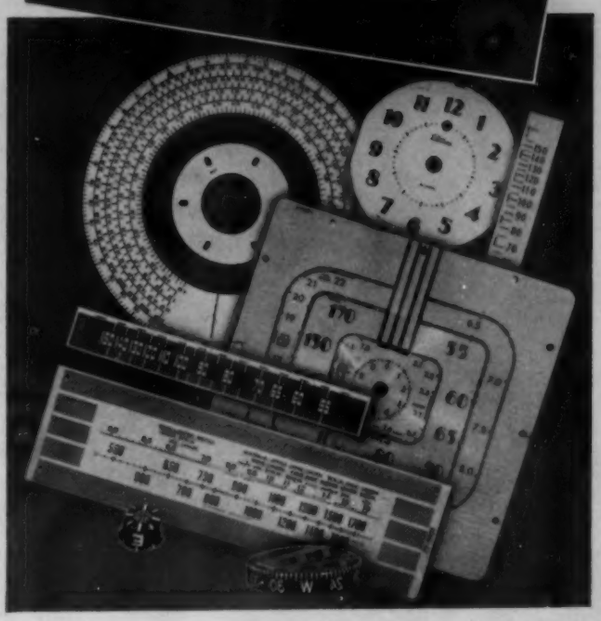
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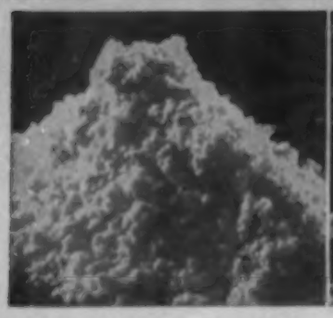
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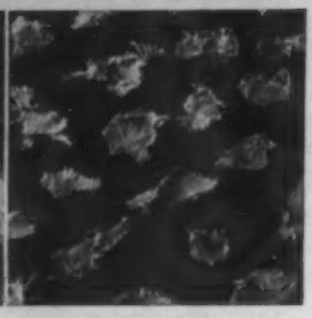
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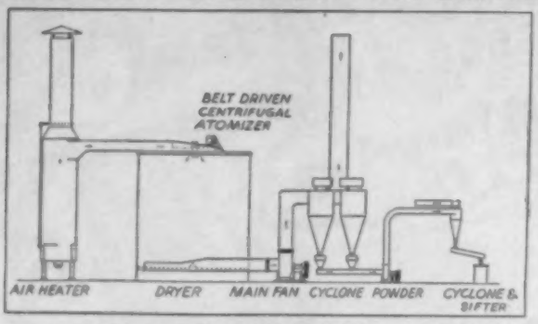
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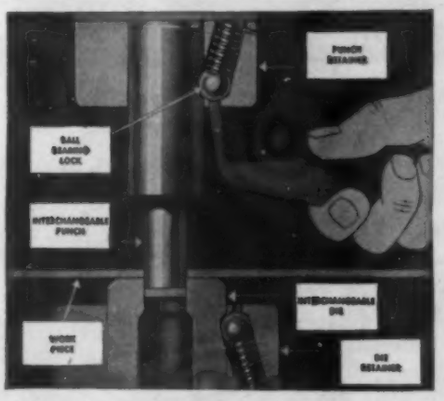
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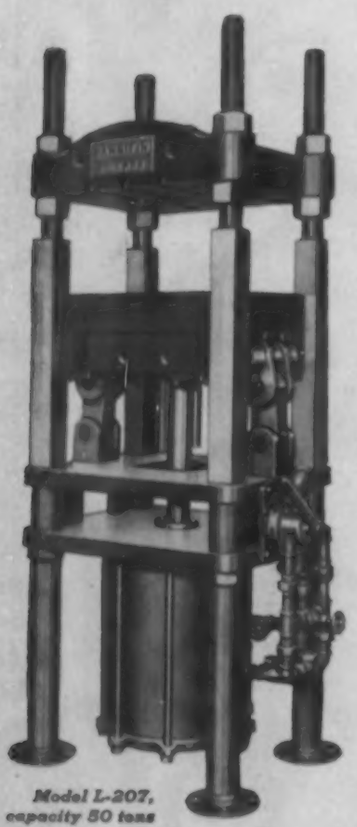
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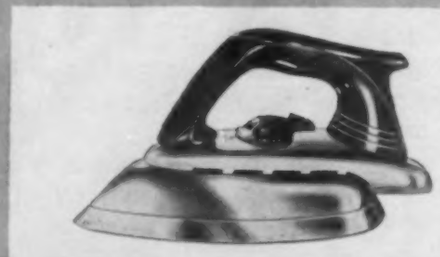
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SUPERINTENDENT FOR INJECTION MOLDING PLANT to assume control and direct all operations in modern building. Prefer man with Engineering background and know-how. Furnish complete information concerning experience, qualifications and salary expected. ARDEE PLASTICS COMPANY, INC., 42-08 Vernon Blvd., Long Island City 1, New York.

WANTED: Used injection machines 4 oz. up, export. It will be impossible for years to get material for all machines in use. Competition is getting tough. Sell now. Write us make, year, and price. Reply Box 1528, Modern Plastics.

WANTED: PLASTIC SCRAP OR REJECTS in any form. Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

AVAILABLE FOR EXPORT from stock: Household Trays, 11" Dia. Black. Ashtrays—Walnut Bakelite—Lipstick Cases—Plastic and Metal combination. Contact Tri-United Plastics, Irvington, N. J. ES 3-1250.

ORGANIC CHEMISTS
A newly organized High Polymer Research Division planning rapid expansion requires a number of organic chemists, preferably with advanced degrees. Positions offer excellent opportunities. Experience in addition and condensation polymerization preferred but not required. Position also available for organic analytical chemist. Address complete details to: Manager, High Polymer Research, Industrial Rayon Corp., W. 98th and Walford Ave., Cleveland, O.

FOR SALE: (1) Watson-Stillman 4 plunger horizontal box type pump completely motorized. 4000# P. S. I. (2) Watson-Stillman 4 plunger horizontal box type pump with motors. (1) Watson-Stillman 4 plunger horizontal box type pump 1" x 8". 5000# P. S. I. with motor. (1) 3 plunger vertical pump, 1" x 6". 5000# P. S. I. First Come, First Served. Located at Sal'e-Press, 386, 388, 390 Warren Street, Brooklyn 2, New York

PLASTICS EXECUTIVE ENGINEER—15 years' experience, including 3 years' development work on low pressure and contact pressure laminating. Will consider consulting work. State your problem: for prototypes or for production. Service offered for product and process development as well as product design. Reply Box C138, Modern Plastics.

Old established manufacturer wants the service of an experienced injection molding executive. Must have expert knowledge of machinery molds and production. Will pay top salary to qualified person. Furnish information regarding experience. Confidential. Reply Box C139, Modern Plastics.

WANTED
SALES REPRESENTATIVES
OR
MANUFACTURERS' AGENTS
Eastern Molder especially qualified for intricate injection, compression and transfer molded parts, specializing in industrial applications requiring metal inserts and equipped for complete assembly of such molded parts desires representation by direct representatives and/or manufacturers' agents in the following territories:
Western New York State, Western Pennsylvania, Ohio, Indiana, Illinois and Michigan.
Please give references, past experience and present connection. Box C140, Modern Plastics.

ORNAMENTAL DESIGNER & MODEL-MAKER: Many years of experience, very creative in new designs, with excellent results in working out models in plastic, metal and plaster paris. Handy on machines. Wishes to come in connection with firm for a position. Small town preferred, located in Ohio, Michigan or Indiana. Best references. Reply Box C141, Modern Plastics.

FOR SALE—1—#BX Lester Injection Molding Machine, Model #1 Special, 4-Ounce Capacity, with Two (2) Extra Cylinders. This machine has been operated very little and is in excellent condition. Reply Box C142, Modern Plastics.

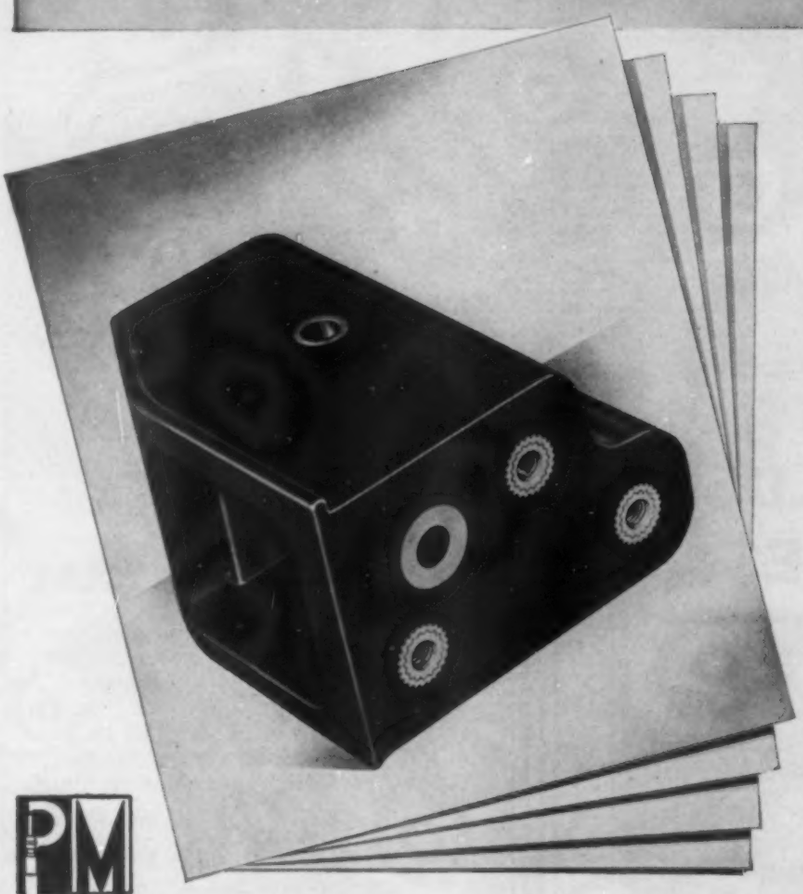
WANTED—Experienced Set-up and Production Man for extrusion molding department. Small but progressive company. Expanding in extrusion. State experience and salary required. Reply Box C143, Modern Plastics.

CHIEF EXPEDITER Construction; operation large Ordinance plant. 29. Labor Relations; Production Planning experience; attorney; Ex-Navy Lieutenant Supply. Desires position. Reply Box C146, Modern Plastics.

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MANUFACTURER'S AGENT desires to represent a first-class molder doing compression, injection, and transfer molding. Aggressive and capable representation for you in Missouri Kansas, Iowa, and Nebraska. Experienced in plastics sales engineering. Particularly interested in making a connection with a firm making a line of proprietary items as well as doing custom molding. Reply Box C145, Modern Plastics.

FOR SALE: Quantity of white Catalin casting resin (phenolic) can be used for casting of novelty items, etc. For details write Box C150, Modern Plastics.

WANTED UREA AND PHENOLIC MOLDING COMPOUNDS, odds and ends, any quantity, any color. LADUBY COMPANY. 23 Temple Street. New Haven, Connecticut.

FOR SALE—(2) 15 Ton STOKES Automatic Compression Molding Machines Nos. 202 and 200D. (1) LUPOMATIC Type F-3036-2C-3 Motor Driven Tumbling Unit complete with motor, cradles and screws. Injection Molding Co., 3827 Independence Avenue, Kansas City 1, Mo. Chestnut 4250.

PLANT SUPERINTENDENT, thoroughly experienced plastics, seeks active interest in expanding business West Coast. Reply Box C147, Modern Plastics.

FOR SALE: HPM 500 ton Mold. Presses 42" x 48"; D. & B. 500 ton 42" x 48"; 150 & 175 Ton; also 20 to 250 Tons from 36" x 36" to 12" x 12"; 40 Ton Broaching Press; 400 Ton Extrus. Pr.; W. S. Hor. 4 Plgr. 1" and 2" x 4" H. & L. Pressure Pumps; HPM 1½" x 6" Vert. Triplex 10 GPM 2700 lbs.; 7 Hydr. Oil Pumps, Vickers, Oilgear, Northern, etc.; Elmes 1" x 4" and 1½" x 4" hor. 4 plgr. 5 to 8 GPM 4500 lbs. and 5500 lbs.; Rumsey 4½" x 8" vert. triplex, 65 GPM 900 lbs.; Elmes 2½" x 4" hor. 2 plgr., 17 GPM 850 lbs.; 10 HP horiz. 1½" x 4" triplex 6 GPM 3000 lbs.; New Vickers 1½" Oil Relief Valves; New Vickers ¾" Flow Control Valves; 2—Adamson 6" Extruders. Hydr. Steam Pumps; Hand Pumps; Low Pressure Pumps 150 to 600 lbs.; Hydr. Accum. Heavy Duty Mixers; Roller Conveyor, Grinders, Pulverizers, Gas Boilers, etc. PARTIAL LISTING. WE BUY YOUR USED MACHINERY. STEIN EQUIPMENT Co., 426 Broome St., NEW YORK 13, N. Y. CANAL 6-8147.

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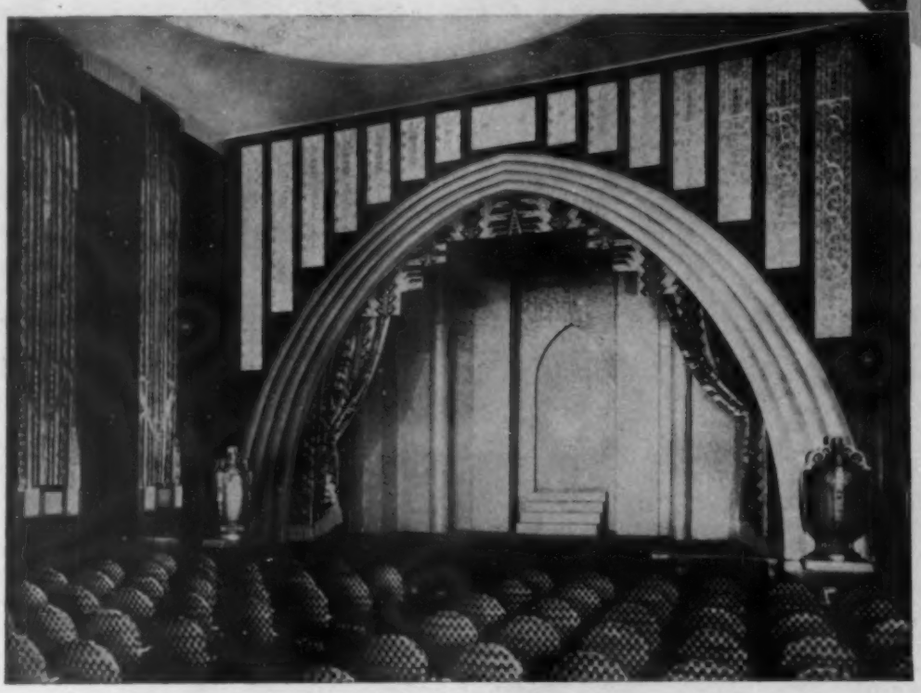
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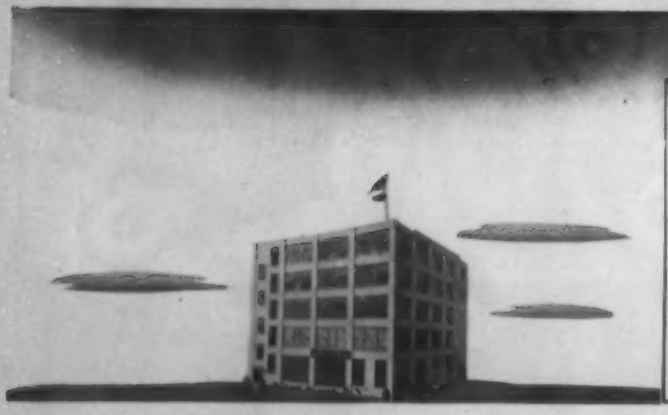






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BAKELITE phenolic resin molding boards, blanks and diced material, produced on standard paper-making machinery, give high moisture resistance and excellent dimensional stability in addition to impact strength . . . and at low cost. The blanks are furnished in disc, rings, rectangles or squares in various thicknesses. A rich, glossy black is the final color.

BAKELITE's engineers will be more than glad to consult with you and help you determine new ways to improve your production and extend your supplies of molding material. Write Department 4 for full information.

TRADE-MARKS

BAKELITE

MOLDING BOARDS and BLANKS

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York



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